Bridge Investment Program Benefit-Cost Analysis Tool

User Manual **v1.1.0**

July 2025

U.S. Department of Transportation
Federal Highway Administration

Publication No. FHWA-HIF-25-009

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this document only because they are considered essential to the objective of the document. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

Non-Binding Contents

Except for the statutes and regulations cited, the contents of this document do not have the force and effect of law and are not meant to bind the States or the public in any way. This document is intended only to provide information regarding existing requirements under the law or agency policies.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. FHWA-HIF-24-084	2. Government Accession No. none	3. Recipient's Catalog No. none	
4. Title and Subtitle Bridge Investment Program Benefit-Cost Analysis Tool User Manual v1.1.0		5. Report Date July 2025 6. Performing Organization Code: none	
7. Author(s) Jonathan Badgley (Volpe) Joseph Reed (Volpe)		8. Performing Organization Report No. none	
9. Performing Organization Name and Address U.S. Department of Transportation John A. Volpe National Transportation Systems Center 220 Binney Road Cambridge, MA 02142-1093		10. Work Unit No. none 11. Contract or Grant No. 693JJ322N300052_P00001	
12. Sponsoring Agency Name and Address Federal Highway Administration 1200 New Jersey Avenue, SE Washington, DC 20590		13. Type of Report and Period 14. Sponsoring Agency Code HPTS-10, HIBS-30	
15. Supplementary Notes The sponsoring agency technical lead was Mona Asudegi, Economist			
16. Abstract This user manual is a companion to the USDOT FHWA Bridge Investment Program Benefit-Cost Analysis Tool v1.1.0. The tool was developed to assist project sponsors who apply for a Bridge Investment Program grant that requires a project benefit-cost analysis. This user manual provides instructions on how to use the tool and provides background on the tool's functionality, calculation procedures, and inputs and outputs.			
17. Key Words Bridge Investment Program, Benefit-Cost Analysis, Benefit-Cost Analysis Tool, User Manual		18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161. http://www.ntis.gov	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized.

Contents

List of Figures

List of Tables

Tables on the Select State NBI Data Worksheet

Tables on the BIP BCA Tool Bridge Worksheet

Tables on the BIP BCA Tool Bridge Worksheet

Version Notes

This manual reflects the BIP BCA Tool version 1.1.0.

- The tool has been revised in version 1.1.0 to include the following adjustments:
  - Updated default values to use the May 13, 2025 USDOT BCA Guidance.[1]
  - Updated to 2025 NBI data.
  - The average annual daily traffic (AADT) entry has been simplified into one table for all modes during construction and benefits period.
  - The tool allows users to enter separate net detour distance values for all modes.
  - The external highway costs for safety and emissions now use May 2025 USDOT BCA Guidance External Highway Cost values from Table A-14: External Highway Use Costs.
  - The Intermittent Closure tables (previously Bridge Tab Tables 26a-d) have been revised to a single table that allows entry of intermittent closures as annual entries in the benefits period (now Bridge Tab Table 22).
  - The Other Unquantified Benefits Not Captured Elsewhere table (previously Bridge Tab Table 51; now Bridge Tab Table 45) has been reformatted to a simpler format using annual entries in the benefits period.
  - The manual now includes guidance for users with bridges that have traffic interdependencies or have "composite bridges."
- In the 2025 NBI data there are two sets of bridges with the same structure number. The structure number for those have been distinguished using the following adjustments:
  - The Massachusetts N100108PDDOTNBI bridge owned and maintained by MassDOT has the structure number N100108PDDOTNBI_A, and the Massachusetts N100108PDDOTNBI bridge owned and maintained by U.S. Fish and Wildlife has the structure number N100108PDDOTNBI_B.
  - The Virginia 000000000001826 bridge owned and maintained by VDOT has the structure number 000000000001826_A, and the Virginia 000000000001826 bridge owned and maintained by U.S. Army Corps of Engineers (USACE) has the structure number 000000000001826_B.

[1] USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs". Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

List of Abbreviations

Abbreviation	Term
AADT	Average Annual Daily Traffic
BCA	Benefit-Cost Analysis
BIP	Bridge Investment Program
CMF	Crash Modification Factor
CRF	Crash Reduction Factor
C&P	FHWA's Conditions and Performance Report
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
IIJA	Infrastructure Investment and Jobs Act
MPH	Miles per Hour
MVMT	Million Vehicle Miles Traveled
NBI	National Bridge Inventory
NBIAS	National Bridge Investment Analysis System
NOFO	Notice of Funding Opportunity
O&M	Operation and Maintenance
USDOT	United States Department of Transportation
VOC	Vehicle Operating Costs
VMT	Vehicle Miles Traveled

Introduction

Purpose

The United States Department of Transportation (USDOT) and its modal administrations provide competitive grants to help build up and maintain a fast, safe, efficient, accessible and convenient transportation system for the American people, today and into the future. There is a myriad of programs available to help States, local governments, Tribes, and other eligible entities plan for and deliver transformative infrastructure projects and services to meet the transportation infrastructure needs for all transportation users.

The Bridge Investment Program (BIP) is a competitive grant program administered by the Federal Highway Administration (FHWA) and provides grants on a competitive basis to improve bridge condition and the safety, efficiency, and reliability of the movement of people and freight over bridges. Section 11118 of the Infrastructure Investment and Jobs Act (IIJA) (Pub. L. No. 117-58, Nov. 15, 2021), established the BIP, codified at 23 U.S.C. 124 [2]. BIP provides funding for replacement, rehabilitation, preservation, and protection of bridges to reduce the overall number of bridges in poor condition, or in fair condition at risk of falling into poor condition. For Bridge Projects under 23 U.S.C. 124, the USDOT FHWA is statutorily required to evaluate specific benefits including whether the benefits of a project outweigh the total project costs [3]. There is a statutory requirement under 23 U.S.C. 124 that the USDOT FHWA evaluate whether a Large Bridge project is cost effective. [4] The USDOT FHWA is also required under 23 U.S.C. 124(f)(1)(B) to develop a template for applicants to use to summarize these project needs and benefits and to enable BIP Bridge grant applicants to use data from the National Bridge Inventory under 23 U.S.C. 114(b) to populate the template.

This Bridge Investment Program Benefit-Cost Analysis Tool (BIP BCA Tool) will allow applicants for either BIP Bridge or Large Bridge grants to summarize project costs and benefits, and obtain data from the NBI in preparation of the economic analysis required for both Bridge and Large Bridge applications.

User Manual Contents

This user manual is intended to provide clarification on the proper setup and application of the tool. It assumes familiarity with BCA, the USDOT BCA guidance [5], and the challenges of applying a BCA to bridge

[2] https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title23-section124&num=0&edition=prelim
[3] The USDOT FHWA must evaluate whether the extent to which the benefits, including those described in 23 U.S.C. 124(f)(3)(B)(i), are more likely than not to outweigh the total project costs (23 U.S.C. 124(f)(3)(B)(ii)).
[4] The USDOT FHWA must evaluate whether a Large Bridge project is cost effective based on an analysis of whether the benefits and avoided costs, described in 23 U.S.C. 124(g)(B), are expected to outweigh the project costs (23 U.S.C. 124(g)(4)(C)).
[5] USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs." Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

investments. In addition, the user manual assumes knowledge of Microsoft® Excel®.

The User Manual is divided into the following sections:

- Getting Started
    - Provides an overview of the BIP BCA Tool v1.1.0, describes the process for downloading and initiating an analysis, provides a basic description of the tool navigation, and discusses the default National Bridge Inventory (NBI) data provided within the tool.
- Benefit-Cost Analysis
    - Describes the benefit and cost sections of the tool with detailed explanations of the information the user will need to provide to calculate benefits and costs for each bridge in the project.
- Appendix A: Frequently Asked Questions
    - Provides a quick guide for addressing common questions about the tool and the required data inputs and outputs.
- Appendix B: Data Sources
    - Describes the main data sources used in the BIP BCA Tool v1.1.0 and the data processing used to generate and format the data.
- Appendix C: BCA Tool Benefit and Cost Calculation Methodology
    - Describes the calculations and methodologies in the tool.

Unless otherwise noted, "table" refers to the table in the BIP BCA Tool v1.1.0. Tables from other worksheets will begin with the worksheet name, then the table number; for example, Table 3 on the Results spreadsheet is called "Results Table 3."

Key Benefit Cost Analysis Concepts

BIP BCA Tool v1.1.0 users should first familiarize themselves with the USDOT BCA guidance.[6] The tool calculations follow the guidance with options for user inputs.

Key Concepts from the USDOT BCA guidance include:

- **Build Scenario**: This represents what would happen in the world with the proposed project.
- **No-build Scenario**: Also referred to as the "baseline," this represents what would happen in the world without the proposed project.
- **Analysis Period**: This is the years of analysis in the BCA. It includes both the years for initial planning and construction, as well as the period of benefits that is being used for BCA.
- **Benefits Period**: This is the subset within the overall period of analysis that is specifically for operations bounded by the project opening and the end of the period of analysis. Projects aimed primarily at capacity expansion or to address other operating deficiencies should use a service life of 20 years. Projects involving the initial construction or full reconstruction of highways or similar facilities should use an expected service life of 30 years.
- **Expected Service Life**: This is the expected life of the asset which reflects the number of years until the same type of action would need to be taken (e.g., a bridge service life may be 75 years at which point the bridge may need to be replaced).
- **Residual Value**: This is the value of the asset at the end of the period of benefits if the project's useful life would extend beyond the period of analysis.

Data Sources

The BIP BCA Tool v1.1.0 uses several data sources.

- **USDOT BCA Guidance**: Monetary and key parameter values from the most recent USDOT BCA guidance are used where appropriate.
- **National Bridge Inventory (NBI)**: Bridge-specific information about the bridge including annual average daily traffic (AADT) and detour length.
- **National Bridge Investment Analysis System (NBIAS):** The NBIAS deterioration model was used to estimate the future year of condition rating for condition ratings 3 and 2. These estimates are used to forecast year of closure and load posting. See the Bridge Conditions and Closures section below for more information about how to use these estimates.

For more detail on how these data sources were processed and included in the tool, see Appendix B: Data Sources.

[6] USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs." Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

Getting Started

This section provides information about how to get started using the BIP BCA Tool v1.1.0, including describing what it is, how to download and use it, and basic controls.

Before You Start: Downloading and Opening the Tool

The tool is distributed as a Microsoft® Office Excel® Macro-Enabled workbook (file extension ".xlsb"). The file name indicates the version number, which is also displayed in the first tab of the worksheet within the tool itself. Users should download the tool from the BIP website and save it to their computer's hard drive. Users should rename the file in accordance with their file keeping structure; renaming the file will not impact the tool's functionality.

Macros must be enabled to use the tool. Excel® will typically have a banner to alert that the tool is macro-enabled and will provide a link to turn on macros. Otherwise, users can enable macros under Options -> Trust Center -> Trust Center Settings in the Excel® file menu.

Navigate the Tool

The tool can be navigated by selecting the desired tab within the workbook. Shortcut navigation is provided at the bottom of each tab.

The tool begins by requesting basic data on the bridge, its use, detours, and bridge AADT followed by sections for capital and operating and maintenance (O&M) costs. The remaining portion of the tool provides sections for each of the benefit categories.

- Construction Disbenefits
- Bridge Condition and Closures (which includes the NBIAS closure forecast)
- Resilience to Weather, Seismic, or other Extreme Events
- Safety Baseline, Detour Safety Benefits, and Safety Countermeasures
- Travel Time and Mobility-Related Benefits
- Mobility-Related Emissions and Other Environmental Benefits
- Other Quantitative Benefits Not Captured Elsewhere
- Manual Entry for AADT by Mode and Year

Each of these benefit category sections (except for the Construction Disbenefits section) begins with a **YES** – **NO** drop-down menu that the user will select to activate the corresponding tables. When the user selects **YES** in the benefit section the tool will also turn-on the appropriate column in

Bridge Tab Table 57a: BCA Annual Calculations. If the user keeps the default value, **NO**, the user can select the hyperlink under the table "If NO, please skip down to next section" or simply scroll down to the next section.

The user supplies all of the AADT data in Bridge Tab Table 3: Annual Average Daily Traffic (AADT).

The BCA Summary provides the discounted benefits, costs, and net benefits by all major categories (Bridge Tab Table 47). The benefits and costs values are linked to the Results spreadsheet.

Initial Tabs

The initial tool tabs of the workbook include:

- **Overview**: This tab provides a brief overview of the tool and navigation.
    - This tab also provides additional formatting to aid in understanding which cells require user input and which cells do not. The color-coding is as follows:
        - Green, bold, and underlined cells represent mandatory user input cells. These cells require numeric input and cannot be left blank, or have "-" or "N/A." The most important cells have 'Required' in the input field for user awareness.
        - Blue, italic, and underlined cells represent optional user input cells.
        - Other cells (including gray and plain text cells) represent a cell that does not require user input, and should not be edited.
- **Select State NBI Data**: This tab allows the user to select NBI data for the State(s) used in the analysis. As the NBI data set is large, this selection is required to reduce the workbook file size. The remaining tabs will only be visible once the user has selected the relevant State(s) and has run the macro.[7]

The remaining tabs of the workbook are made visible once the user selects the State NBI Data. These additional tabs include:

- **Example Bridge**: This tab is an example bridge analysis that can be used for reference to understand the bridge tab functionality and explore how the tool works overall. This tab is the basic format for how all bridge tabs work. New bridge tabs can be generated by clicking the "Add New Bridge Tab" button or by entering Ctrl + Shift + I on the keyboard (see the following section for more about adding and deleting bridge tabs). Users should not delete this tab.
- **Results**: This tab presents the summary results of the analysis using a dynamic table that adds and removes columns for each new bridge tab added or deleted. Users can also describe any unquantified benefits of the project on this tab.
- **Defaults**: This tab contains default values from the USDOT BCA guidance. The tab is viewable for

[7] This step is provided to address the file size issue of the NBI data. Users who are not able to download and open the Excel® workbook should contact BridgeInvestmentProgram@dot.gov and someone from the BIP team will prepare a version of the tool with the requested NBI data.

reference but is locked for editing.

- **NBI Data**: This tab contains the 2025 NBI data. The tab is viewable for reference but is locked for editing. The data in this tab is filtered to States that are selected in the "Select the State NBI Data" workbook.

Selecting State NBI Data

Open the "Select State NBI Data" tab and select up to three States using the table shown below (Select State NBI Data Tab Table 1).

Select State NBI Data Tab Table 1: State NBI Data Selection

State Number	State	NBI State ID
State 1	mystate	0
State 2	-	0
State 3	-	0

Then click the "Select State NBI Data" button at the top of the State NBI Selection sheet or press Ctrl + Shift + I on your keyboard (Figure 1).

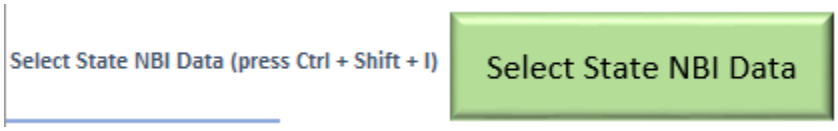

Figure 1: "Select State NBI Data" Button

WARNING: The selection processing may take up to 5 minutes.

Adding and Deleting Bridge Tabs

To add additional bridge tabs, click the "Add New Bridge" button at the top of the Example Bridge tab (or any bridge tab) or press Ctrl + Shift + B on your keyboard (Figure 2). The tool will prompt the user to name the new bridge spreadsheet and will create a new bridge tab with the user-supplied bridge name. On the Results tab the BCA Results table (table 1) will add a column for the new bridge.

Figure 2: "Add New Bridge" button

To delete a bridge tab, click either the “Delete Bridge” button at the top of the bridge tab or press Ctrl + Shift + D on your keyboard (note: this button is not on the Example Bridge Tab) (Figure 3). The tool will confirm deletion with a “Yes/No” dialog box. If yes is clicked, the current bridge tab will be deleted and its entry on the Results tab BCA Results table will also be deleted. Sensitivity analysis tabs can be deleted this way as well.

Figure 3: “Delete this Bridge” button

To change the name of a bridge tab, click either the “Change Bridge Name” button at the top of the bridge tab or press Ctrl + Shift + D on your keyboard (note: this button is not on the Example Bridge Tab) (Figure 4).

Figure 4: "Change Bridge Name" button

If the application includes multiple bridges, be careful not to double-count benefits on different bridge tabs.[8] Each bridge tab can only represent the benefits for a single bridge. For example, capital costs from a bridge tab are summed in the Summary Results table on the Results tab, so the capital costs on each bridge tab should reflect only those capital costs for that bridge.

WARNING: Users should NOT cut and paste the bridge spreadsheet into another workbook. Each bridge spreadsheet is linked to workbook data in the Defaults and NBI Data spreadsheets.

WARNING: Users must use the buttons described above to add or delete a bridge. Do not attempt to add a bridge by using Excel’s® function to copy a worksheet. Do not attempt to delete a bridge by using the Excel® function to delete the worksheet. Do not change a spreadsheet name by using the Excel® function for renaming a spreadsheet.

[8] The BIP BCA Tool v1.1.0 cannot be used if the construction costs for a bundle of bridges cannot be separated.

Benefit-Cost Analysis Tool

This section provides directions on how to use the tool to compute a BCA for a single bridge as well as a description of the methodology and calculations used. Each benefit and cost category presented in the tool is separated into the sections as ordered in the bridge tab. This section also covers other items related to the analysis process, including how to analyze multiple bridges, how to interpret the results, and sensitivity testing.

Analysis for an Individual Bridge

This section describes the process for analyzing a single bridge. The information is organized vertically so that users do not need to scroll left and right to find information or provide input.

Gather Data Before Starting the BCA

To complete a BCA for a single bridge using the tool the following information will be required:

- Bridge information, including State, County, and Structure Number.
- Detailed project description for build and no-build scenarios including:
    - Project construction costs
    - O&M costs in the build and no-build scenarios
    - Construction time-period
    - AADT for passenger vehicles, trucks, buses, and, if available, pedestrian and cyclists.
    - Information specific to the benefits being claimed, such as annual average crashes or the annual probability of weather/seismic events.
- Alternatives to the NBI values for each bridge (such as AADT and detour length), if the user does not want to use the NBI default data.
- Information specific to the benefits being claimed; some benefits may need information like annual average crashes, the annual probability of weather/seismic events, or pedestrian and cyclists AADT.

Example Bridge

The Example Bridge tab (also referred to as the Bridge Tab) is used to demonstrate the functionality of the tool using an example project. Each of the tables in this tab contain the inputs and values that are used in the tool. The walkthrough provides additional description of the example project where necessary in the following sections.

The example project is the reconstruction of a bridge to avoid future load posting and closure and to improve safety by adding a crossing turn lane on an approach to the bridge, improve travel time by adding a shoulder, improve pedestrian and cycling facilities on the roadway, improve rainwater runoff,

and protect the bridge from damage from seismic events. Construction will take place from 2025 to 2027 and require closing one half of the bridge for 75 days annually resulting in delays for vehicle users. As the project is a reconstruction, the benefits period is 30 years, from 2028 to 2057. Without the project, the bridge would be load posted in 2035 for 50 percent of all trucks and buses, load posted in 2042 for all trucks and buses, and finally closed to all traffic in 2050.

Enter Bridge Information

The Bridge and Project Overview section provides identifying information about the bridge using the State, County, and Structure Number dropdowns to pull forward NBI data for the particular bridge (Bridge Tab Table 1). The first dropdown identifies the State, the second identifies the county, and the third uniquely identifies the bridge with the structure number. The user can use these dropdowns to find the appropriate structure number. The State and structure number are required to uniquely identify the bridge, while the county dropdown is used to filter down to a smaller list of bridges within the State. After selecting the State, County, and Structure Number, the gray cells of Bridge Tab Table 1 (column B) will show the NBI data.

Bridge Tab Table 1: Bridge Variable

Bridge Variables	Bridge Values
State	**mystate**
County	**mycounty**
Structure Number	**001**
Inventory Route	00000
Feature Intersected	Example Roadway'
Facility Carried	Example Route'
Latitude	00° 00' 00.00"
Longitude	-00° 00' 00.0"
Bridge Length (mi)	0.92
Bypass, Detour Length (mi)	2.50
Owner	mystate
Functional Class, Rural/Urban	07
Bridge Road Type	Rural - Major Collector
Bridge Road Type Simple	Rural
Year Built	1970
Year Reconstructed	1985
Lanes on the Structure	2
NBI AADT Year	2019
NBI AADT Future Year	2029
NBI AADT	6000
NBI AADT Future	7800
Reference Cell 1	mystatemycounty
Reference Cell 2	mystate001

The Project Timeline table (Bridge Tab Table 2) has required inputs for the current year, the first year in which future construction costs occur, the last year in which construction costs occur, the first year in which the project is open to the public,[9] and the years of benefits. The first and last year of analysis are computed by the tool, the discount and dollar year is set by the USDOT BCA guidance, and the base year of the NBI is set by the latest NBI year.

[9] At this time, the tool is unable to estimate partial year benefits, and accordingly the user should use the first full year when the project is open. For example, if construction ends in September 2026 and the project opens in October 2026, the user should enter 2027 as the first full year of project opening.

Bridge Tab Table 2: Project Timeline

Timeline Variables	Timeline Values
First Year of Construction Costs	**2025**
Last Year of Construction Costs	**2027**
Project Opens (Start of Benefits)	**2028**
Years of Benefits for Analysis	**30**
First Year of Period of Analysis	2028
Last Year of Period of Analysis	2057
Discount and Dollar Year	2023
Base Year of NBI	2025

The AADT table (Bridge Tab Table 3) requires AADT for passenger vehicles, trucks, buses, cyclists and pedestrians for both the build, assuming no load posting or closure, and no-build scenarios. NBI values are provided for reference, including forecasts of AADT for the period of benefits based on the implied growth rate from NBI current year AADT and future AADT. [10]

WARNING: If the bridge will be load posted or closed during construction, enter the AADT values as they would be if the bridge were not load posted or closed in Bridge Tab Table 3, and enter the appropriate year of load posting and closure in Bridge Tab Table 20 and Bridge Tab Table 21.

[10] See the Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges for how it treats Average Daily Traffic (ADT), Item 29, which is the total AADT for the roadway, which includes trucks and may also include buses. Users will need to distinguish between bus and passenger AADT. https://www.fhwa.dot.gov/bridge/mtguide.cfm

Bridge Tab Table 3: Annual Average Daily Traffic (AADT)

Calendar Year	Analysis Year	NBI Passenger	NBI Trucks	Passenger - No-Build	Trucks - No-Build	Bus - No-Build	Pedestrian - No-Build	Cyclist - No-Build	Passenger - Build	Trucks - Build	Bus - Build	Pedestrian -Build	Cyclist - Build
2025	-2	6372	708	6372	6696	**90**	**100**	**50**	**6372**	**708**	**90**	**100**	**75**
2026	-1	6534	726	6534	726	**90**	**102**	**51**	**6534**	**726**	**90**	**102**	**77**
2027	0	6696	744	6696	744	**90**	**104**	**52**	**6696**	**744**	**90**	**104**	**78**
…	…	…	…	…	…	…	…	…	…	…	…	…	…
Explanation and Source:	N/A	NBI	NBI	**NBI**	**NBI**	**Transit Service**	**Local Counts**	**Local Counts**	**NBI**	**NBI**	**Transit Service**	**Local Counts**	**Local Counts + induced demand estimate of 50%**

The Detour and Bridge Information table (Bridge Tab Table 4) requires input on the detour route including the detour road type, the net length, and average speed of the detour for each vehicle mode (passenger vehicles, trucks, and buses). The table will calculate the base travel time on the detour route by mode. The table also requires bridge length and average speed information. The default detour average speed values come from the average speed values for each road type estimated from the FHWA vehicle hours traveled (VHT) modeling. The NBI bridge length value does not include the length of the roadway approach so users should enter a value for bridge length that includes the approach length when appropriate. Bridge length is used to calculate noise, congestion, and emissions disbenefits for induced vehicle AADT, and the vehicle operating cost benefits for induced vehicle AADT. These are the external costs that drivers induced to use the bridge impose on others. Average travel time for each mode is calculated based on the average speed and the detour lengths provided. For pedestrians and cyclists, the average speeds and distances come from the May 2025 USDOT BCA Guidance table A-13.

WARNING: Detour length should represent the net detour, which is detour length minus the original route length.

Bridge Tab Table 4: Detour and Bridge Information

Detour Details	Reference	User Value	Explanation and Source
Bridge Length (mi)	0.92	**0.92**	-
Average Speed on Bridge (mph)	47.0	**35.0**	**-**
Passenger Detour Road Type	Rural	**Rural - Major Collector**	**-**
Truck Detour Road Type	Rural	**Rural - Major Collector**	**-**
Bus Detour Road Type	Rural	**Rural - Major Collector**	**-**
Passenger Net Detour Length (mi)	2.5	**1.7**	**Calculated on Google Maps**
Truck Net Detour Length (mi)	2.5	**1.7**	**Calculated on Google Maps**
Bus Net Detour Length (mi)	2.5	**1.7**	**Calculated on Google Maps**
Pedestrian Net Detour Length (mi)	2.5	**2.5**	-
Cyclist Net Detour Length (mi)	2.5	**2.5**	-
Passenger Detour Average Speed (mph)	47.0	**47.0**	-
Truck Detour Average Speed (mph)	47.0	**47.0**	-
Bus Detour Average Speed (mph)	47.0	**47.0**	-
Passenger Detour Average Travel Time (min)	3.2	2.2	N/A
Truck Detour Average Travel Time (min)	3.2	2.2	N/A
Bus Detour Average Travel Time (min)	3.2	2.2	N/A
Pedestrian Detour Travel Time (min)	46.9	46.9	N/A
Cyclist Detour Travel Time (min)	15.3	15.3	N/A

The Travel Assumptions (Bridge Tab Table 5) table provides default values of vehicle occupancy, shares of intercity commuting and business travel, and value of time for roadway users. If using different values than the USDOT BCA guidance, please provide an explanation and the source. For bus occupancy, users will need to provide an explanation and the source as there is no default value.

Bridge Tab Table 5: Travel Assumptions

Parameters	Reference	User Value	Explanation and Source
Average Car Occupancy	1.52	**1.52**	-
Share of Long-Distance Personal Travel	0.0%	**0%**	-
Value of Time - Long-Distance Personal Travel	$27.10	**$27.10**	-
Share of Business Travel	11.8%	**11.8%**	-
Value of Travel Time - Business	$33.50	**$33.50**	-
Value of Travel Time - Personal	$19.40	**$19.40**	-
Value of Travel Time - All Purposes	$21.10	$21.10	-
Walking, Cycling, Waiting, Standing, and Transfer Time	$38.80	**$38.80**	-
Truck Driver	$35.70	**$35.70**	-
Bus Driver	$42.60	**$42.60**	-
Average Bus Occupancy	N/A	**15**	**Data from MyCounty Transportation Authority**

Capital Costs and Residual Values

The capital cost and residual values section has four tables that require user input.

The Expenditure Dollars Option table (Bridge Tab Table 6) provides a drop-down button to select whether the costs entered are in nominal (*year of expenditure)* or in constant dollars (inflation adjusted), and a place to enter the future inflation rate if one applies. If the user selects nominal dollars, the tool will automatically convert nominal costs into constant dollars using the inflation rate for capital costs entered into this table. [11]

Bridge Tab Table 6: Expenditure Dollars Option

Are costs entered in year of expenditure dollars (not adjusted for inflation)?	**Yes**
Enter future inflation rate for capital costs.	**2%**

Enter the year of the costs and the nominal value of the costs in the Already Incurred Costs table (Bridge

[11] See USDOT BCA guidance sections 3.3 and 3.4 on inflation and discounting adjustments.
USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs." Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

Tab Table 7). The tool will automatically apply the appropriate discounting.

Bridge Tab Table 7: Already Incurred Costs

Year	Costs	Real Costs	Discounted Costs
2023	***$100,000***	$100,000	$100,000
2024	***$100,000***	$98,039	$91,625
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Enter the future capital costs in the correct year of expenditure dollars (as specified in Bridge Tab Table 6) in the Capital Costs table (Bridge Tab Table 8). Capital costs generally include the cost of land, labor, material and equipment rentals used in the project's construction. In addition to direct construction costs, capital costs may include costs for project planning and design, environmental reviews, land acquisition, utility relocation, or transaction costs for securing financing. The year of construction is automatically generated based on the project timeline information. The tool will compute the real discounted capital costs for each year, by applying the discount rate and the inflation factor in the Real Cost column. If the year is the same as the base year used for discounting in the latest USDOT Guidance, then no inflation adjustment is made. If the year of the cost is prior to the discounting base year, then the inflation factor comes from the USDOT BCA guidance. If a user selects a future inflation factor (a value greater than 0) in Bridge Tab Table 6, the tool automatically applies it to capital costs for years after the base year.

Bridge Tab Table 8: Capital Costs

Year	Costs	Real Costs	Discounted Costs
2025	**$9,000,000**	$8,650,519	$7,555,698
2026	**$9,000,000**	$8,480,901	$6,922,941
2027	**$9,000,000**	$8,314,609	$6,343,175
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-
N/A	-	-	-

The Capital Cost Summary table provides the total capital costs, the real capital costs, and the total discounted capital costs for the project based on input entered in Bridge Tab Table 7, Bridge Tab Table 8, and Bridge Tab Table 9.

Bridge Tab Table 9: Capital Cost Summary

Total Capital Costs:	$27,200,000
Total Real Capital Costs:	$25,644,068
Total Discounted Capital Costs:	$21,013,441

The Residual Value table requires input for calculating the residual value of the project components (Bridge Tab Table 10). Enter the share of the capital costs and the asset life for each separate component of the project where appropriate. The tool will automatically calculate the residual value at the end of the period of benefits using linear depreciation and apply discounting as required by the USDOT BCA guidance.

Bridge Tab Table 10: Residual Value

Share of Capital Costs	Asset Life (Years)	Explanation; including asset component
100%	75	*The improvement has an expected life of 75 years at which point it would need to be redeployed, or a new bridge constructed*
0%	0	-
0%	0	-
0%	0	-
100%	Summation	N/A

Operating and Maintenance (O&M) Costs

In the O&M Costs for Construction and Operation Periods table (Bridge Tab Table 11), all O&M costs should be entered in *real* terms, with the user noting the appropriate year of dollars.

Bridge Tab Table 11: O&M Cost Year

Year of O&M Cost Dollars	2025

Use the Operation and Maintenance Costs table (Bridge Tab Table 12) to enter the annual costs for each calendar year of the project for the no-build and build scenarios. These costs should be entered as the year of dollar entered in Bridge Tab Table 11. The tool will automatically adjust these values to the appropriate year of dollar and apply discounting. O&M costs between the current year and end of construction year can be entered as well.

In the example, the project is expected to be closed in the no-build scenario in 2050 and will not require additional O&M thereafter, and additionally the no-build scenario will see O&M costs in the no-build scenario. However, in the build scenario the project will require additional O&M costs throughout the analysis period.

Bridge Tab Table 12: O&M Costs for Construction and Operation Periods

Calendar Year	Analysis Year	No Build Annual Cost	Build Annual Cost	Discounted O&M Costs
2025	-2	$10,000	$-	$8,262
2026	-1	$-	$-	$-
2027	0	$-	$-	$-
2028	1	$-	$-	$-
2029	2	$10,000	$1,000	$5,673
2030	3	$-	$-	$-
2031	4	$-	$-	$-
2032	5	$-	$-	$-
2033	6	$10,000	$1,000	$4,328
2034	7	$-	$-	$-
2035	8	$-	$-	$-
2036	9	$-	$-	$-
2037	10	$10,000	$1,000	$3,302
2038	11	$-	$-	$-
2039	12	$-	$-	$-
2040	13	$-	$-	$-
2041	14	$10,000	$1,000	$2,519
2042	15	$-	$-	$-
2043	16	$-	$-	$-
2044	17	$-	$-	$-
2045	18	$10,000	$1,000	$1,922
2046	19	$-	$-	$-
2047	20	$-	$-	$-
2048	21	$-	$-	$-
2049	22	$10,000	$1,000	$1,466
2050	23	$-	$-	$-
2051	24	$-	$-	$-
2052	25	$-	$-	$-
2053	26	$-	$1,000	$(124)
2054	27	$-	$-	$-
2055	28	$-	$-	$-
2056	29	$-	$-	$-
2057	30	$-	$1,000	$(95)
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-
N/A	N/A	$-	$-	$-

Construction Disbenefits

The "Construction Disbenefits" section is for the travel impacts during construction that include direct impacts to travelers on the bridge such as increased travel time and increased crash risk, as well as costs associated with circuitry due to delays or bridge closure.

In the Description of Construction Traffic Management Plan table (Bridge Tab Table 13), provide an explanation of the construction traffic management plan. The tool assumes that there will be construction disbenefits based on the types of projects that are appropriate for the BIP competitive grants. If there are no anticipated construction disbenefits then set the number of days of impact per year to 0 in tables Bridge Tab Table 14.

If the bridge is already closed or load posted, the tool will automatically adjust the AADT for the construction disbenefits to reflect the load posting or closure in the construction period.

Bridge Tab Table 13: Description of Construction Traffic Management Plan

Describe the traffic management plan during construction and the expected impacts, especially if the construction disbenefits detour or capacity reduction is substantially different than the bridge closure situation.	**Construction will close one lane of traffic on the bridge alternating directions 75 days per year. Pedestrians and cyclists will continue to be able to use the roadway during construction with some expected delay. Crash risk is expected to increase marginally given the construction zone.**

Construction disbenefits can be estimated using any combination of days of full detour or a partial capacity reduction in tables Bridge Tab Table 14 and Bridge Tab Table 15 to reflect the user's construction traffic management plan.

WARNING: Days of Impact Annually entered in Bridge Tab Table 14 and Bridge Tab Table 15 should not sum to more than 365 days in a given year. Doing so will lead to double counting the traffic impacts of construction.

To estimate the partial capacity construction disbenefits, enter the AADT by mode, minutes of delay by mode, and days of impact annually by year to calculate the total discounted travel time costs (Bridge Tab Table 14). Enter the percent increase in crashes to calculate the total discounted crash costs (Bridge Tab Table 15). These crash costs are estimated as a percent increase in the baseline crashes for the roadway on the theory that work zones may increase the inherent crash risk on the roadway. If no crash increases are expected due to the construction enter "0" percent for each year. See the section "Safety Baseline, Detour Safety Benefits, and Safety Countermeasures" below for how to enter the baseline crash rate in table Bridge Tab Table 32.

Bridge Tab Table 16: Partial Capacity Construction Disbenefits

Year	Days of Impact Annually	Vehicle Delay (minutes)	Truck Delay (minutes)	Bus Delay (minutes)	Pedestrian Delay (minutes)	Bicyclist Delay (minutes)	Percent Increase in Crashes due to Work Zone
2025	75	0.5	0.5	0.5	0	0	5%
2026	75	0.5	0.5	0.5	0	0	5%
2027	75	0.5	0.5	0.5	0	0	5%
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-
N/A	-	-	-	-	-	-	-

To estimate full detour construction disbenefits, simply enter the number of days annually that traffic will be fully detoured in Bridge Tab Table 15.

Bridge Tab Table 17: Full Detour Construction Disbenefits

Year	Days of Impact Annually
2025	0
2026	0
2027	0
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-
N/A	-

Other construction disbenefits can be entered in Bridge Tab Table 16 by providing the cost estimate by year and an explanation of the disbenefits. In the example, there are no other construction disbenefits.

Bridge Tab Table 18: Other Construction Disbenefits

Year	Other Quantified Construction Disbenefits	Explanation of Disbenefits
2025	-	-
2026	-	-
2027	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-
N/A	-	-

Bridge Condition and Closures

The Bridge Condition and Closures section provides the posting and closure estimates from the NBIAS model with the ability for the user to provide alternative values with information supporting deviations from the NBIAS model closure estimate. This is distinct from bridge closures due to extreme events, which is the Resilience to Weather, Seismic, or other Extreme Events section. The tool automatically calculates the travel time, vehicle operating and safety benefits from avoided detouring.

Select YES if there will be bridge load posting or closure benefits in the Condition Impact Option table (Bridge Tab Table 17).

Bridge Tab Table 19: Condition Impact Option

Will the project improve or preserve the bridge's condition in a way that reduces the risk of closure and/or load posting?	**YES**

The Bridge Condition and Closures section will automatically populate with data from the NBI on the current bridge status. The tool provides the NBIAS deterioration model estimate of the year when the bridge is expected to have an overall condition rating of 3 and 2, the year estimated to reach superstructure condition rating 4 and 3, and the current superstructure condition rating and the current operating rating (Bridge Tab Table 18 and Bridge Tab Table 19). The tool calculates the expected year of load posting and closure based on these values (see Appendix B for more details on how those estimates are calculated).

Bridge Tab Table 20: Bridge Details

Variable	Value
Bridge Currently Closed or Load Posted? (NBI)	A
NBI Coding Translation	Open, no restriction
Current Superstructure Condition Rating	5
Current Operating Rating (metric tons)	40.0

Bridge Tab Table 21: Forecasted Condition Rating

Bridge Component and Rating	Condition Rating Reference Value	NBIAS Forecast Year
Overall Condition Rating 3	3	2038
Overall Condition Rating 2	2	2048
Superstructure Condition Rating 4	4	2038
Superstructure Condition Rating 3	3	2043

Enter load posting of up to three levels of expected future load posting in the Anticipated Load Postings table (Bridge Tab Table 20). If the bridge is currently load posted, enter the current year and load posting level for trucks and buses. After entering the estimated year of posting, the user should enter the expected percentage reduction in truck traffic and in bus traffic for the load postings.

Bridge Tab Table 22: Anticipated Load Postings

Load Posting Level	Forecast Year	Year	% Reduction in Truck Traffic	% Reduction in Bus Traffic	Explanation for year if not reference; for % reduction
Load Posted, level 1	2038; 50% for Truck and Bus	**2038**	**50%**	**50%**	**Based on engineering study included as appendix to BCA Narrative**
Load Posted, level 2	2043; 100% for Truck and Bus	**2043**	**100%**	**100%**	**Based on engineering study included as appendix to BCA Narrative**
Load Posted, level 3	N/A	**2070**	**0%**	**0%**	-

For indefinite closures, enter the year the closure will begin and the percent reduction in all traffic (e.g., 100 percent in the case of full closure, or 25 percent closure in the case of one closed lane of a four-lane bridge) (Bridge Tab Table 21). The NBIAS estimated year of closure is presented for reference. Without supporting information from the applicant, FHWA assumes bridge closure will match the NBIAS bridge closure year.

Bridge Tab Table 23: Anticipated Closure

Closure Level	Forecast Year	Year	% Reduction in All Traffic	Explanation for year if not reference; for % reduction
Closure	2052; Based on when year Overall Condition Rating 2 is reached plus average time to closure of 3.98 years	**2050**	**100%**	**Based on engineering study included as appendix to BCA Narrative**

If the bridge closure will be partial in duration rather than indefinite use the Short-term or Intermittent Closures table to enter the number of days of closure and the percent reduction in all traffic on the bridge due to the closure (Bridge Tab Table 22). In the example, there are no intermittent closures.

Bridge Tab Table 24: Short-term or Intermittent Closures

Year	Days of Closure	% Reduction in All Traffic	Explanation
2028	-	*0%*	-
2029	-	*0%*	-
2030	-	*0%*	-
2031	-	*0%*	-
2032	-	*0%*	-
2033	-	*0%*	-
2034	-	*0%*	-
2035	-	*0%*	-
2036	-	*0%*	-
2037	-	*0%*	-
2038	-	*0%*	-
2039	-	*0%*	-
2040	-	*0%*	-
2041	-	*0%*	-
2042	-	*0%*	-
2043	-	*0%*	-
2044	-	*0%*	-
2045	-	*0%*	-
2046	-	*0%*	-
2047	-	*0%*	-
2048	-	*0%*	-
2049	-	*0%*	-
N/A	-	*0%*	-
N/A	-	*0%*	-
N/A	-	*0%*	-
N/A	-	*0%*	-
N/A	-	*0%*	-

Resilience to Weather, Seismic, or Other Extreme Events

The Resilience to Weather, Seismic, or other Extreme Events section covers two approaches to enter the benefits of resilience. The first uses a probability-consequence framework, which calculates the impact of the resilience investment using three different levels of weather, seismic, or other extreme events that are specified by the user while the second is a free-form alternative approach that allows the user to calculate benefits based on any other approach and provide an explanation of that approach.

Select **YES** in Bridge Tab Table 23 to activate the resilience benefit section of the spreadsheet.

Bridge Tab Table 25: Resiliency Option

Will the project improve the bridge's resiliency to weather, seismic, or other extreme events, reducing damage and/or closures, or other service interruptions?	**YES**

Select **YES** in Bridge Tab Table 24 to activate the probability-consequence approach.

Bridge Tab Table 26: Probability Resilience Option

Are you providing a probability-consequence analysis of the resilience impacts?	**YES**

Weather, seismic, or other extreme events can be entered in three consequence severity types:

- **Closure, Traffic Restriction, or Load Restriction Only**: This consequence level refers to an event causing closure of the asset reducing some amount of capacity for at least one day a year but not structural damage to the asset requiring repair. Traffic restriction may occur when a lane or speed reduction is imposed on the bridge or results from an onsite temporary detour. A load restriction will occur when a load posting is imposed (ex. no trucks allowed). An example event that could cause this consequence would be a recurring flooding event that overtops the bridge or inundates roadways on approach to the bridge.
- **Lesser Structural Damage (Level one)**: This consequence level can be any level of damage as long as it is correctly correlated with the event and its probability is supported in the application narrative or BCA memo. The user inputs the days of closure, travel reduction, and repair costs for both the build and no-build scenarios.
- **Larger Structural Damage (Level two)**: This is a higher consequence level of damage to the bridge, which might cause fatalities or injuries on the structure itself. Alternatively, the number of fatalities or injuries could be left at zero to model a higher impact but less frequent event. Repair costs should restore the bridge to its condition and service life before the hazardous event. Per USDOT BCA guidance, the no-build scenario cannot include rebuilding the bridge so any maintenance, repair, or operational costs under the larger structural damage consequence cannot amount to bridge reconstruction.

Note that the tool is hazard-agnostic; the calculations can handle any type of weather or seismic event. However, the user must provide supporting documentation in supplementary materials or BCA memo.

A user will enter the annual probability of the event occurring in the project opening year and the final year for any event type. While the impacting event probability is the same for the build and no-build scenarios, the event impacts will be different in the build and no-build scenarios. The tool allows users to assume the probability of the impacting event can change over time. The Annual Probability Calculator (Bridge Tab Table 25) calculates the growth rate over the benefit period using the compound annual growth rate function, and the growth rate is used to define the annual probability of event

occurrence in the calculation of the benefits elsewhere in the tool. Recurring closures that occur more than once in a given year can be entered by entering an annual probability of event occurrence greater than 100 percent in Bridge Tab Table 25, e.g., enter 200 percent if the event is expected to occur twice a year.

In the example project, the hazard event levels have a probability of event occurrence of 1 percent, 0.1 percent, and 0.01 percent, which were determined by an engineering study. The engineering study also demonstrates how the bridge would be damaged with and without the project and the expected consequences of that damage in terms of the expected maintenance/repair/operating costs, the expected injuries and fatalities given an event, the repair duration and how much traffic will be detouring during repair.

Bridge Tab Table 27: Annual Probability of Event occurrence

Consequence Level	Project Open Year	Final Year	Growth Rate	Explanation and source
Volume Capacity Reduction Only	*1.00%*	*1.00%*	0.000%	**Based on MyCounty seismic report included as appendix to BCA Narrative**
Structural Damage	*0.10%*	*0.10%*	0.000%	**Same as above**
Failure	*0.01%*	*0.01%*	0.000%	**Same as above**

Next, the user can enter the requested variables for the relevant event types (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). Each of the events requires the user to provide the duration of the closure/service interruption, the capacity reduction for passenger vehicles, the capacity reduction for truck traffic, and the maintenance/repair/operations costs. The user can enter these estimates for both the no-build and build scenarios. Note that the reduced traffic is using the detour route. Make sure that the days of closure or service interruption is apportioned to the frequency of the event rather than the total number of days a year, e.g., an event that is expected to occur twice annually with a duration of impact of five days in the no-build and 2 days in the build scenario should be entered as 5 and 2 days respectively in the Days of Closure of Service Interruption row.

Bridge Tab Table 28: Volume Capacity Reduction Impacts

Impact	No Build	Build
Days of Closure or Service Interruption	2	1
Passenger Volume Capacity Reduction (%)	25%	25%
Truck Volume Capacity Reduction (%)	25%	25%
Bus Volume Capacity Reduction (%)	25%	25%
Bike/Ped Volume Capacity Reduction (%)	25%	25%
Maintenance/Repair/Operation Costs ($)	$20,000	$10,000

Bridge Tab Table 29: Lesser Structural Damage (Level one) Impacts

Impact	No Build	Build
Days of Closure or Service Interruption	10	5
Passenger Volume Capacity Reduction (%)	50%	50%
Truck Volume Capacity Reduction (%)	50%	50%
Bus Volume Capacity Reduction (%)	50%	50%
Bike/Ped Volume Capacity Reduction (%)	50%	50%
Maintenance/Repair/Operation Costs ($)	$200,000	$50,000

The Larger Structural Damage (Level two) category also asks for the expected number of fatalities and injuries (Bridge Tab Table 28). The user can enter these estimates for both the no-build and build scenarios. Note again, that per USDOT BCA guidance, the no-build scenario cannot include rebuilding the bridge so any maintenance, repair, or operational costs under the failure consequence cannot amount to bridge reconstruction.

Bridge Tab Table 30: Larger Structural Damage (Level two) Impacts

Impact	No Build	Build
Days of Closure or Service Interruption	25	5
Passenger Volume Capacity Reduction (%)	100%	100%
Truck Volume Capacity Reduction (%)	100%	100%
Bus Volume Capacity Reduction (%)	100%	100%
Bike/Ped Volume Capacity Reduction (%)	100%	100%
Maintenance/Repair/Operation Costs ($)	$2,000,000	$100,000
Number of Fatalities in Year 1	1	0
Number of Injuries in Year 1	10	0

The alternative weather, seismic, and extreme weather event benefits calculation approach is available if the user is using an alternative method for assessing the impact of the resilience project or for calculating the benefits. Other calculation methods may include calculations that yield a benefit value but do not precisely follow the tool's approach or could include an engineering evaluation that determines if the bridge design is sufficient to withstand a given level of extreme event. If a benefit value is calculated, it may be included in Bridge Tab Table 46. If a benefit value is not calculated the

results of the calculation method or the results of a qualitative assessment may be explained in the Results sheet section designated for unquantified benefits.

If providing an explanation of the other calculation methods used select YES on Bridge Tab Table 29.

Bridge Tab Table 31: Other Resilience Method Option

Are you providing an explanation of the other calculation method used?	**NO**

Enter your explanation in Bridge Tab Table 30 for this method. A reference to the materials in your application that cover this information is acceptable. If your application materials include documentation of this alternative approach simply note which document(s) provides this information.

Bridge Tab Table 32: Other Resilience Method Explanation

Explanation	-

WARNING: In accordance with the USDOT BCA guidance, a user should not include replacing the structure in a no-build scenario. The applicant should assume that the facility/structure remains closed, and the tool will compute the detour costs.

Safety Baseline, Detour Safety Benefits, and Safety Countermeasures

The Safety Baseline, Detour Safety Benefits, and Safety Countermeasures section contains three subsections. The first subsection is for entering the historical crash rates. The second subsection is for entering the impact of safety countermeasures deployed on the bridge itself. The third subsection is for entering safety benefits from avoided detouring—which occur due to avoiding increased crash risk on the detour route.

Select whether you will be using KABCO or General crash costs, per the USDOT BCA Guidance, in Bridge Tab Table 31.

Bridge Tab Table 33: Crash Cost Estimate Option

Are you using KABCO or General crash cost estimates?	**KABCO**

Bridge Tab Table 32 Historical Crash Data provides the data used for computing construction disbenefits and safety countermeasure benefits. Enter historical crash data for the bridge (including approaches if appropriate given the safety countermeasure or construction zone) by entering the years of data that the crashes represent and the number of crashes for each crash type, and provide a source for the crash

cost including the calendar years of the data in Bridge Tab Table 32.[12] Per USDOT BCA guidance, either KABCO[13] or general injury and fatality costs can be used, but not both. Please see May 2025 USDOT BCA guidance "Valuing Injuries and Fatalities" section and Appendix A Table A-1 for more information on the difference between the KABCO scale and the injury and fatal crash cost approaches. The tool calculates the annual average crashes for the bridge.

Bridge Tab Table 34: Historical Crash Data

Crash Type	Years of Data	Number of Crashes	Average Annual Crashes	Average Annual Crash Cost Historical	Source for Crash; Calendar Years of Data
Property Damage Only	*10*	*10*	1	$9,500	**2018-2024, from MyCounty law enforcement; details in BCA narrative.**
No Injury	*10*	*2*	0.2	$1,060	**Same as above**
Possible Injury	*10*	*1*	0.1	$11,800	**Same as above**
Non-incapacitating	*10*	*0*	0	$-	**Same as above**
Incapacitating	*10*	*0*	0	$-	**Same as above**
Killed	*10*	*0*	0	$-	**Same as above**
Injured (severity unknown)	*10*	*1*	0.1	$22,980	**Same as above**
Injury	-	-	N/A	N/A	-
Fatal	-	-	N/A	N/A	-
Total Annual Crash Cost	N/A	N/A	N/A	$45,340	N/A

If the project will deploy a safety countermeasure on the bridge itself, select **YES** in Bridge Tab Table 33, enter the years of benefit in Bridge Tab Table 34, and enter the appropriate crash modification factor (CMF) for each crash type, the CMF number from the CMF Clearinghouse if used, and a source for the CMF in Bridge Tab Table 35. Be certain to use the CMF and not the crash reduction factor (CRF). Convert the CRF to a CMF by taking [1 – CRF]. Link to the specific CMF that applies on the FHWA's Crash Modification Clearing House website and specify the study and conditions for the CMF used.[14] See the USDOT BCA guidance for how to select appropriate CMFs and for how to compute the CMF when multiple safety countermeasures are being deployed.[15] Additional guidance for multiple CMFs can be

[12] The FHWA Fatality Analysis Reporting System (FARS) dataset may be a good resource for those agencies that do not have access to high-quality crash data for their area. Accessed from: https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars

[13] The KABCO scale follows: K = fatal injury; A = severe injury; B = other visible injury; C = possible injury; O = property damage only.

[14] FHWA. CMF Clearinghouse. Accessed from: https://www.cmfclearinghouse.org/

[15] USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs". Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

found on FHWA's CMF Clearinghouse.[16] The tool will calculate the average annual crash cost reduction based on the historical crash rate and the CMF.

Bridge Tab Table 35: CMF Option

Does the project improve safety on the bridge via a Crash Modification Factor (CMF)?	**YES**

Bridge Tab Table 36: CMF Time Frame

Category	Benefit Period	Year
Initial Year of CMF-related Safety Benefits	2028	**2028**
Last Year of CMF-related Safety Benefits	2057	**2057**

In the example project, the CMF is for a positive offset left-turn lane for one of the bridge approaches, and has the CMF ID of 276 in FHWA's CMF Clearinghouse.

[16] FHWA's CMF Clearinghouse has several resources available including instructional videos and pre-recorded webinars that provide information about when and how to calculate combined CMFs. FHWA. "Using CMFs." Accessed from: http://cmfclearinghouse.org/using_cmfs.cfm

Bridge Tab Table 37: Safety Countermeasures – Crash Costs Avoided

Crash Type	CMF	Average Annual Crashes Reduced	Average Annual Crash Costs Avoided	CMF Reference Number, if CMF Clearinghouse value is used (https://www.cmfclearinghouse.org/)	Explanation and Source for CMF
Property Damage Only	*0.74*	0.26	$2,470	*CMF ID: 276*	**Introducing a positive offset left-turn lane for the bridge approach. http://www.cmfclearinghouse.org/detail.cfm?facid=276**
No Injury	*0.74*	0.05	$276	*CMF ID: 276*	**Same as above**
Possible Injury	*0.74*	0.03	$3,068	*CMF ID: 276*	**Same as above**
Non-incapacitating	*0.74*	0.00	$-	*CMF ID: 276*	**Same as above**
Incapacitating	*0.74*	0.00	$-	*CMF ID: 276*	**Same as above**
Killed	*0.74*	0.00	$-	*CMF ID: 276*	**Same as above**
Injured (severity unknown)	*0.74*	0.03	$8,567	*CMF ID: 276*	**Same as above**
Injury	-	0.00	$-	-	-
Fatal	-	0.00	$-	-	-
Total Annual Crash Cost	N/A	N/A	$14,381	N/A	N/A

If closure, resilience mitigations, or safety countermeasures are selected, the Safety Benefits due to Avoided Detouring will be calculated using the External Highway Costs monetary values from the May 2025 USDOT BCA Guidance table A-14.[17]

Travel Time and Mobility-Related Improvements

The Travel Time and Mobility-Related Improvements section captures travel time related benefits due to investments made to improve mobility on the bridge itself. These are travel time savings *separate* from travel time savings from avoided detouring. For example, if the new bridge replaces an at-grade intersection with ramps.

Select **YES** on Bridge Tab Table 36 to select whether these benefits apply.

[17] USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs". Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

Bridge Tab Table 38: Travel Time Option

Does the project improve travel time/mobility, separate from reducing bridge closures or load posting?	**YES**

Enter the time saved *in minutes* per vehicle in the project opening year and the final year in Bridge Tab Table 42.

Bridge Tab Table 39: Travel Time Savings

Initial or Last Year	Benefits Period	Year	Minutes Saved Per Vehicle	Explanation
Initial Year	2028	**2028**	**0.4**	**Lane configuration will improve travel time as detailed in BCA narrative.**
Last Year	2057	**2057**	**0.4**	**-**

If you have not already calculated the minutes saved per vehicle, you can use the optional Bridge Tab Table 38 to calculate the minutes saved using distance of the bridge and the speed in the build and no-build scenario. Enter the speed with and without the project for both the project opening year and the final year, and then enter the distance traveled in miles. The tool calculates minutes saved which you can enter in Bridge Tab Table 37. Enter these calculated values (column E) into Bridge Tab Table 38 for Minutes Per Vehicle Saved (column D).

Note: Bridge Tab Table 38 is not referenced in the benefits calculation formulas. To enter travel time savings, you must enter minutes saved values in Bridge Tab Table 37.

In the example, the travel time benefits for existing users are limited because the distance of the bridge and its approach as shown in Bridge Tab Table 38.

Bridge Tab Table 40: Optional Travel Time Savings Calculator

Year	Speed (mph) - No-build	Speed (mph) - Build	Distance Traveled (Miles)	Minutes Saved Per Vehicle
Initial Year	*35*	*47*	*0.92*	0.4
Final Year	*35*	*47*	*0.92*	0.4

Mobility-Related Emissions and Other Environmental Benefits

Select **YES** in Bridge Tab Table 39 if the project has wildlife connectivity, noise, and/or water runoff benefits.

Bridge Tab Table 41: Other Environmental Benefits Option

Does the project have benefits related to improved wildlife connectivity, reduced noise, or improved water runoff?	**NO**

Use Bridge Tab Table 40 to enter benefit values for wildlife connectivity, noise, and/or water runoff. Enter the annual benefit in dollars in the first year of project opening and the annual expected growth rate for the benefit value. Be sure to include the explanation of the benefit and a link to the source documentation of the benefit for the reviewers to verify.

Noise in this section is the noise benefit that accrues from noise countermeasures deployed on the bridge itself (i.e., noise walls). The noise-related benefits from avoiding the detour, as specified in the May 2025 USDOT BCA guidance Appendix Table A-14, are calculated separately. The example does not feature other environmental benefits.

Bridge Tab Table 42: Other Environmental Benefits

Environmental Benefit Category	Annual Benefit ($) in Initial Year	Annual Growth Rate (%)	Initial Year	Last Year	Explanation and Source
Wildlife Connectivity	-	*0%*	-	-	-
Noise	-	*0%*	-	-	-
Water Runoff	-	*0%*	-	-	-

Pedestrian and Bicyclist Benefits

Enter **YES** in Bridge Tab Table 41 if pedestrians or cyclists will be impacted by the project, including due to detouring or through pedestrian and cyclist facility improvements.

Bridge Tab Table 43: Improved Pedestrian/Bicycling Option

Does the project improve pedestrian/bicycling facilities or detour pedestrians or bicyclists?	**YES**

Bridge Tab Table 42 has YES/NO dropdowns to select which pedestrian and cyclist improvements are included in the project, and it has several input cells to select the specific degree of impact of that improvement, including sidewalk width, upslope, MPH reduced, vehicles reduced, and the average number of crossings.

Bridge Tab Table 44: Pedestrian and Cyclist Improvement Information

Improvement	Input
Extend Pedestrian Sidewalk Width?	*YES*
If the sidewalk is widened, by how many additional feet?	***10***
Reduce upslope by 1%?	*NO*
How many upslope percents reduced?	-
Reduces traffic speed by 1 mph (for speeds ≤45 mph)?	*NO*
How many mph reduced?	-
Reducing Traffic Volume by 1 Vehicle per Hour (for ADT ≤ 55,000)?	*NO*
How many vehicles reduced?	-
Install a Marked Crosswalk (for ADT ≥ 10,000)?	*NO*
Average number of crossings on new marked crosswalks per trip?	-
Install a Signal for a Pedestrian Crossing (for ADT ≥ 13,000)?	*YES*
Average number of crossings on new signalized crosswalks per trip?	***1***
Add a Cycling Path with At-Grade Crossings?	*NO*
Add a Cycling Path with no At-Grade Crossings?	*NO*
Add a Dedicated Cycling Lane?	*NO*
Create a Cycling Boulevard/"Sharrow"?	*NO*
Add a Separated Cycle Track?	*NO*

Use Bridge Tab Table 43 to enter the percent of trips induced from non-active modes, which are the share of new users of the pedestrian and cycling facility that are predicted to switch from non-active

modes such as motor vehicles, as well as the length of the new or improved facility in miles. The USDOT BCA guidance notes that applicants should ensure that mortality reduction benefits of induced active transportation are only applied to trips induced from non-active transportation modes within the relevant age ranges for each mode. Absent more localized data on the proportion of induced trips coming from non-active transportation modes, applicants may apply a general assumption of 89% of induced trips falling into that category, assuming a distribution matching the national average travel pattern.

Bridge Tab Table 45: Pedestrian and Cyclist Inputs

Parameter	Reference	User Value
Trips Induced from non-active modes (%)	89%	**89%**
Length of the new or improved pedestrian/cycling facility (mi)	N/A	***1***

Other Monetized Benefits Not Captured Elsewhere

Select **YES** in Bridge Tab Table 44 if there are any other monetized benefits not captured above.

Bridge Tab Table 46: Additional Monetized Benefits Option

Does the project have other monetized benefits not captured above?	**NO**

Use Bridge Tab Table 45 to specify monetized benefits not captured elsewhere using real dollars (i.e., the base year dollar of the analysis). Please include an explanation and source that details what the cost involves, particularly if there are different kinds of costs included in the figure. The example does not feature any other monetized benefits not captured elsewhere.

Bridge Tab Table 47: Other Monetized Benefits Not Captured Elsewhere

Year	Annual Other Monetized Benefits	Explanation and Source
2028	-	-
2029	-	-
2030	-	-
2031	-	-
2032	-	-
2033	-	-
2034	-	-
2035	-	-
2036	-	-
2037	-	-
2038	-	-
2039	-	-
2040	-	-
2041	-	-
2042	-	-
2043	-	-
2044	-	-
2045	-	-
2046	-	-
2047	-	-
2048	-	-
2049	-	-
2050	-	-
2051	-	-
2052	-	-
2053	-	-
2054	-	-
2055	-	-
2056	-	-
2057	-	-

Reviewing Calculations

Summary calculation tables are provided on each Bridge Tab to allow review of the calculations and results. These tables do not require any input from the user. The column names for each table are listed in the bulleted list below.

The calculations of benefits and disbenefits for Safety, Travel Time and Congestion, VOC, Resilience, Health and Amenity, Emissions, and Noise and Other Environmental Impacts are calculated in Tables 47–54 with a separate column for each sub-category of those benefits, including those from avoided detours, avoided intermittent detours, construction disbenefits, etc. Calculations from each of the Tables 47–54 feed into Table 46: BCA Summary as their discounted values. Tables 47–54 allow greater visibility into the impact of alternative input values to the overall analysis and can help users potentially identify errors in their inputs or analysis methodology. If values, such as Annual Safety Calculations have used a computation method different from the BIP BCA Tool v1.1.0, those values can be directly entered into Table 47, of course with appropriate documentation for the computational method.

Rather than reproduce the Tables 46–54, the columns within each table are listed:

- Bridge Tab Table 46: BCA Summary (Discounted)
    - Calendar Year
    - Analysis Year
    - Safety (See Table 47)
    - Travel Time and Congestion (See Table 48)
    - VOC (See Table 49
    - Resilience (See Table 50)
    - Health and Amenity (See Table 51)
    - Emissions (See Table 52)
    - Noise and Other Environmental (See Table 53)
    - Maintenance Cost Savings
    - Other Monetized Benefits
    - Residual Value
    - Total Benefits
    - Total Costs
    - Net Present Value
    - 7 Percent Discount Rate
- Bridge Tab Table 47. Annual Safety Calculations
    - Calendar Year
    - Analysis Year
    - Avoided Crashes Due to CMF
    - Avoided Load Posting and Closure Detour Safety
    - Avoided Closure Detour Safety – Intermittent
    - Construction Disbenefits Partial Capacity Safety

    - Construction Disbenefits Full Detour Safety
    - Total Safety Benefits
    - Total Safety Benefits Discounted
    - 7 Percent Discount Rate
- Bridge Tab Table 48. Annual Travel Time Calculations
    - Calendar Year
    - Analysis Year
    - Travel Time and Mobility-Related Benefits
    - Avoided Detour Travel Time Due to Load Posting or Closures
    - Avoided Detour Travel Time Due to Load Posting or Closures - Intermittent
    - Avoided Congestion Due to Load Posting or Closures
    - Avoided Congestion Due to Load Posting or Closures – Intermittent
    - Congestion Disbenefits Due to Induced Demand
    - Construction Disbenefits Due to Partial Capacity Travel Time
    - Construction Disbenefits Due to Full Detour Travel Time
    - Construction Disbenefits Due to Full Detour Congestion
    - Total Travel Time
    - Total Travel Time Discounted
    - 7 Percent Discount Rate
- Bridge Tab Table 49: Annual VOC Calculations
    - Calendar Year
    - Analysis Year
    - Avoided Detour VOC Due to Load Posting or Closures
    - Avoided Detour VOC Due to Load Posting or Closures – Intermittent
    - VOC Disbenefits Due to Induced Demand
    - Construction Disbenefits Full Detour VOC
    - Total VOC Benefits
    - Total VOC Benefits Discounted
    - 7 Percent Discount Rate
- Bridge Tab Table 50: Annual Resilience Calculations
    - Calendar Year
    - Analysis Year
    - Avoided Maintenance/Repair/Operation Costs
    - Avoided Fatalities and Injuries Due to Larger Structural Damage
    - Avoided Detour Travel Time Costs
    - Avoided Detour Pedestrian and Bicyclists Travel Time
    - Avoided Detour Vehicle Operating Costs
    - Avoided Detour Safety
    - Avoided Detour Noise
    - Avoided Detour Congestion
    - Avoided Detour Emissions

    - Total Resilience Benefits
    - Total Resilience Benefits Discounted
    - 7 Percent Discount Rate
- Bridge Tab Table 51: Annual Health and Amenity Calculations
    - Calendar Year
    - Analysis Year
    - Mortality Reduction Benefits
    - Pedestrian Facility Improvement Benefits
    - Cycling Facility Improvement Benefits
    - Total Health and Amenity Benefits
    - Total Health and Amenity Benefits Discounted
    - 7 Percent Discount Rate
- Bridge Tab Table 52: Annual Emission Calculations
    - Calendar Year
    - Analysis Year
    - Emission Benefits Due to Avoided Load Posting and Closure
    - Emission Benefits Due to Avoided Load Posting and closure - Intermittent
    - Emission Disbenefits Due to Induced Demand
    - Emission Construction Disbenefits
    - Total Emission Benefits
    - Total Emission Benefits Discounted
    - 7 Percent Discount Rate
- Bridge Tab Table 53: Annual Noise and Other Environmental Calculations
    - Calendar Year
    - Analysis Year
    - Noise Benefits Due to Avoided Load Posting or Closures
    - Noise Benefits Due to Avoided Load Posting or Closures - Intermittent
    - Noise Disbenefits Due to Induced Demand
    - Noise Construction Disbenefits
    - Other Environmental Benefits
    - Total Noise and Other Environmental Benefits
    - Total Noise and Other Environmental Benefits Discounted
    - 7 Percent Discount Rate

Multiple Bridges and Bundling

Some applications may include investments on multiple bridges. The BCA tool is designed to allow users to calculate benefits and costs for each bridge independently. Bridges can be added as described above in the “Adding and Deleting Bridge Tabs” section. The tool can accommodate up to 250 bridges in a single project file (the limitation is on the number of tabs that a workbook can generate).

The tool can be used to calculate BCAs on each bridge included in the project, and also calculate an

overall BCA for the entire project by summing all benefits and costs across all the bridges in the project.

In some cases, projects with multiple bridges may benefit from bundling where costs are reduced through pooling administrative and procurement costs across multiple bridge investments within a project. Those bundling savings are not properly part of the benefit cost analysis because they are already included in the build scenario. To account for bundling cost savings in the build scenario, ensure that the capital costs entered for each bridge reflect the capital costs inclusive of the bundling savings.

The BIP does require applicants to note where bundling has reduced the cost of the projects overall. To include these savings in the tool, describe the bundling savings in the text box on the results tab (see next section for more details on where to describe any bundling cost savings).

Traffic Interdependencies and Composite Bridges

The following information should be considered when there are multiple bridges in an analysis.

Traffic Interdependencies

Traffic interdependencies between bridges represent a potentially significant complication to any analysis of projects on multiple bridges. Any analysis with potential traffic interdependencies should carefully consider whether there are interdependencies and how those interdependencies impact the BCA for the investments on separate bridges.

Traffic interdependencies generally occur under the following conditions:

1) General Interdependence: Traffic users of one bridge that regularly use another during the same trip.[18]
2) Detour Interdependencies: A bridge(s) is along another bridge's designated detour route. A special case of this is when one bridge serves as the detour route for the other bridge.
3) Composite Bridges: The configuration of bridges causes any user of one bridge to necessarily also use the other bridge(s). This can occur where bridges are sequenced end to end, but this can also occur where there are segments of roadway between bridges.

In these cases, it is important to understand how traffic conditions on one bridge, such as construction, load posting, or closure will impact the traffic levels on another bridge. In some cases, it may not be possible to decompose the share of traffic of one bridge's AADT that uses another during the same trip. BIP applicants should describe these interdependencies with as much detail and data as available.

In complex situations, such as dense urban environments where multiple bridges are in the project set, a

[18] Of course, many bridges in a given state could be theoretically involved in the same trip, but users should apply a reasonableness standard. If bridges are within the same city and traffic regularly in the course of normal trips use both bridges, then they should be considered interdependent.

travel demand model may be the best approach for understanding how construction, load posting, or closures will impact demand on other bridges. If using a travel demand model, users should be careful to analyze how traffic is impacted by the closure or load posting of each bridge in the year in which the closure or load posting status changes.

For composite bridges applying to the BIP competitive grant program, see the guidance in the next section for how to best incorporate those into your BIP BCA application.

Composite Bridges

Composite Bridges occur when a set of bridges is configured so that a traffic user of one bridge will necessarily also traverse the other bridges. For instance, consider a highway segment where there are two bridges in both the north-bound directions without highway exits between the two bridges. In that circumstance, drivers would necessarily cross both north-bound bridges without an opportunity to avoid one of the bridges. Composite bridges may be configured end-to-end, or they may have roadway segments between them.

In these circumstances, the closures and load postings for each bridge in a composite are duplicative and this causes benefits to be double counted in the tool and the BCA results to be inaccurate. It is important in these circumstances to ensure that the analysis does not double count the benefits of avoided detouring or load posting. For example, if Bridge A is expected to close in 2040, Bridge B is expected to close in 2045, and Bridges A and B are sequenced so that all traffic using Bridge A necessarily uses Bridge B, then it would introduce double counting to create a bridge analysis for both bridges with those anticipated closures. The detouring as a result of Bridge B starting in 2045 would already be occurring due to the closure of Bridge A in 2040.

If users determine they have a composite bridge in the project set, users will need to adjust their analysis to treat all the bridges in the composite as a joint bridge for the BCA. The steps to accomplish this are as follows:

1) Create a separate bridge tab for each bridge in your analysis including all of those that are part of a composite bridge and complete the BCA for each bridge independent of the traffic interdependencies.
2) Create a Composite Bridge Tab by adding a new Bridge Tab with the word ‘composite’ in the name, and using the following guidance on parameter values:
    a. The AADT for all modes should match the most representative bridge, for each year of the analysis. The AADT values for all the bridges in a composite should conceptually be identical if the bridges are a true composite, but in practice they may not be identical so users should be careful to verify the AADT values.
    b. The net detour distance for each mode of the composite bridge should be realistic, whether it is the same as the NBI net detour values (if all bridges in the composite have the same value) or it is calculated using an independent method. The NBI net detour

values for all the bridges in a composite should conceptually be identical if the bridges are a true composite, but in practice they may not be identical so users should be careful to verify the NBI detour values.

c. Bridge length should be adjusted to contain the distance of the joint bridge.
d. The O&M costs for the build and no-build scenario should be the annual sum of those for each of the bridges in the composite.
e. The project costs for the composite bridge should be the sum of the project costs for the bridges in the composite, including the already-incurred costs.
f. The closure year should be the earliest closure date of the bridges in the composite. This can be accomplished by comparing the information from Bridge Tab Table 21 to review the NBIAS forecasted closure year.
g. The load posting year and share of truck and bus traffic should be that of the earliest load posting of bridges in the composite. If there are increasing levels of load posting for bridges through the analysis period, use the Level 2 and Level 3 load posting in Table 20 to represent the escalation of load posting levels across all the bridges.

3) On the Results tab, set all the individual bridge tabs that are part of the composite to "NOT INCLUDED" in Table 1 and set the composite bridge to "INCLUDED."

Results

The BCA summary information is available on the Results Tab Table 1. This table includes all bridges added to the workbook including any added using the New Bridges or Sensitivity Analyses buttons as discussed above. The "Include in Analysis?" row provides a dropdown to select whether to include the bridge in the total BCR and Net Present Value.

WARNING: Users must select "Not Include" in the drop-down menu for the Example Bridge, otherwise it will be included in the total BCR calculation.

Results Tab Table 1: BCA Results

Category	Example Bridge	Total	Percent of Total Benefits [19]
Include in Analysis?	**INCLUDE**	N/A	**N/A**
Safety	$5,006,978	$5,006,978	**19%**
Travel Time	$14,427,342	$14,427,342	**54%**
VOC	$4,779,862	$4,779,862	**18%**
Resilience	$21,575	$21,575	**0%**
Health and Amenity	$919,906	$919,906	**3%**
-	$-	$-	**0%**
Emissions	$124,409	$124,409	**0%**
Other Environmental	$7,693	$7,693	**0%**
Maintenance	$27,251	$27,251	**0%**
Other Benefits	$-	$-	**0%**
Residual Value	$1,542,019	$1,542,019	**6%**
Total	$26,857,035	$26,857,035	**100%**
Total Discounted Costs	$21,013,441	$21,013,441	**N/A**
BCR	1.28	1.28	**N/A**
Net Present Value (NPV)	$5,843,595	$5,843,595	**N/A**

Enter the qualitative benefits, including the bundling cost savings, alternative design cost savings, and any other unquantified benefits in Results Tab Table 2. The other unquantified benefits can include national or regional economic growth.

In the example, the overall BCR is 1.28 with benefits primarily coming from safety, travel time reducing detouring due to load posting and closure.

Results Tab Table 2: Unquantified Benefits

Unquantified Benefits	Qualitative Description of Benefits
Bundling Cost Savings	-
Alternative Design Cost Savings	-
Other Benefits	-

Use the dropdowns in Results Tab Table 3 to select whether to include benefit categories in the analysis. Note: This functionality is for BIP BCA reviewers.

[19] Benefit categories may not sum 100 percent due to rounding.

Results Tab Table 3: Benefit Categories Option

Category	Include in Analysis?
Safety	INCLUDE
Travel Time	INCLUDE
VOC	INCLUDE
Resilience	INCLUDE
Health & Amenity	INCLUDE
-	INCLUDE
Emissions	INCLUDE
Other Environmental	INCLUDE
Maintenance	INCLUDE
Residual Value	INCLUDE
Other Benefits	INCLUDE

Sensitivity Testing

The tool provides a simple method for conducting sensitivity testing. Users can create a duplicate tab in the tool workbook using the "Add a Sensitivity Analysis for Current Bridge" button located at the top of each bridge tab that is created (not on the Example Bridge Tab) (Figure 5).

WARNING: Do not create a sensitivity analysis for a bridge by manually copying a bridge tab. The results table will not recognize bridge tabs created manually by the user.

When clicked, the tool makes a copy of the currently active bridge tab, copying all of the same user-supplied values, and names the tab "[current bridge name] + "_sns" and adds the sensitivity to Table 1 in the Results tab.

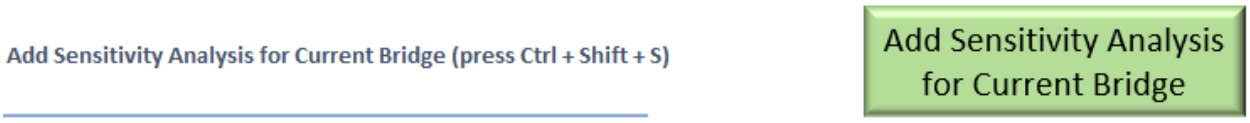

Figure 5: "Add Sensitivity Analysis for Current Bridge" button

Use the sensitivity tabs to test the impact of alternative inputs and assumptions. Review the impact of those adjustments side-by-side with the original analysis on the Summary Review table on the Results tab. Results Tab Table 1 (4) below shows the results table with an example of the sensitivity analysis as it contains a column for "New Bridge" and the sensitivity analysis of that bridge called "*New Bridge_sns*".

Results Tab Table 1 (4): BCA Results with Sensitivity Analysis

Category	Example Bridge	*New Bridge_sns*	New Bridge	Total	Percent of Total Benefits [20]
Include in Analysis?	**INCLUDE**	*INCLUDE*	**INCLUDE**	N/A	**N/A**
Safety	$5,006,978	$-	$-	$5,006,978	**19%**
Travel Time	$14,427,342	$-	$-	$14,427,342	**54%**
VOC	$4,779,862	$-	$-	$4,779,862	**18%**
Resilience	$21,575	$-	$-	$21,575	**0%**
Health & Amenity	$919,906	$-	$-	$919,906	**3%**
-	$-	$-	$-	$-	**0%**
Emissions	$124,409	$-	$-	$124,409	**0%**
Other Environmental	$7,693	$-	$-	$7,693	**0%**
Maintenance	$27,251	$-	$-	$27,251	**0%**
Other Benefits	$-	$-	$-	$-	**0%**
Residual Value	$1,542,019	$-	$-	$1,542,019	**6%**
Total	$26,857,035	$-	$-	$26,857,035	**100%**
Total Discounted Costs	$21,013,441	$-	$-	$21,013,441	**N/A**
BCR	1.28	$-	$-	1.28	**N/A**
Net Present Value (NPV)	$5,843,595	$-	$-	$5,843,595	**N/A**

[20] Benefit categories may not sum 100 percent due to rounding.

Appendix A: Frequently Asked Questions

The following questions represent frequently asked questions regarding the tool. This FAQ section is meant to provide a quick guide for users, however much of this information is also provided either earlier in the user guide or within the tool itself.

Question: How do I enter future AADT values in the baseline if the bridge is expected to close?

Answer: Enter the expected future AADT assuming the bridge does not close. The closure costs are calculated under the Bridge Condition and Closure section, and those calculations are based on the expected level of travel absent the closure.

Question: The file is too large for me to use on my machine. How can I get a smaller version with just the State NBI data I need?

Answer: Contact the FHWA support team (BridgeInvestmentProgram@dot.gov) with the State(s) for which you want data. A BIP BCA Tool v1.1.0 with the specified State(s) records will be emailed to you.

Question: What is the difference between a CMF and a CRF?

Answer: A CMF is a Crash Modification Factor whereas a CRF is a Crash Reduction Factor. A CMF describes the percent of crashes that remain after the treatment, whereas the CRF describes the percent of crashes that are reduced. If a treatment is anticipated to reduce crashes by 20%, the CMF is 80% and the CRF is 20%. The BIP BCA Tool v1.1.0 uses the CMF.

Question: Why are vehicle operating costs not included? How do I add fuel cost savings?

Answer: Vehicle operating costs, including fuel savings, are calculated within the tool as benefits of avoided detours based on the USDOT BCA guidance monetary values for vehicle operating costs.

Question: How do I enter the hours of travel time for the detour route?

Answer: The detour route travel time is calculated for each vehicle type (passenger, truck, bus, cyclist, and pedestrians) based on the detour distance and average speed along the route. For cyclists and pedestrians, the USDOT BCA guidance provides values for average speed.

Question: Can I enter in partial years of construction and period of benefits?

Answer: The tool does not allow for partial years of construction or benefits at the present time.

Question: How do I apply discounting?

Answer: Discounting is automatically applied based on the USDOT BCA guidance.

Question: One or more of my benefit categories are not computing. How do I fix this?

Answer: The tool requires numerical inputs for any green, bold, and underlined cells, and the most critical cells have the word “Required” to alert the user. Search CTRL+F for any instances of required and replace with an appropriate numerical value (may be “0”), and otherwise check each green, bold, and underlined cell.

Question: What do I do if I need to delete a bridge tab?

Answer: The Example bridge tab should not be deleted. To delete any bridge tabs that the user has created, use the “Delete Bridge” at the top of each bridge sheet which will remove the tab and remove the bridge from the Results Tab Table 1.

Appendix B: Data Sources

USDOT BCA Guidance – BCA Default Values

May 2025 USDOT BCA guidance tables of monetary values and key parameters, tables A-1 through A-13 are used as default values where appropriate. The default values can be found in the Defaults tab of the workbook and in the USDOT BCA guidance document online. [21] The v1.1.0 tool uses the May 2025 guidance. If the guidance is updated then FHWA will either issue a new BIP BCA Tool or provide directions to users on how to update the current model.

National Bridge Inventory (NBI) – Identifying Information and Bridge Defaults

The National Bridge Inventory (NBI) is a database of information on all bridges and culverts in the United States, which is compiled and managed by FHWA. Data are collected by the States and submitted to FHWA annually. The BCA Tool and the NOFO tool are populated with NBI 2025 data and are not filtered or processed in any way. The NBI fields used in the BCA Tool include the following:

- STATE_CODE_001
- COUNTY_CODE_003
- RECORD_TYPE_005A
- ROUTE_NUMBER_005D
- FEATURES_DESC_006A
- FACILITY_CARRIED_007
- LAT_016
- LONG_017
- DETOUR_KILOS_019
- OWNER_022
- FUNCTIONAL_CLASS_026
- YEAR_BUILT_027
- TRAFFIC_LANES_ON_028A
- ADT_029
- YEAR_ADT_030
- OPEN_CLOSED_POSTED_041
- YEAR_RECONSTRUCTED_106
- PERCENT_ADT_TRUCK_109
- FUTURE_ADT_114
- YEAR_OF_FUTURE_ADT_115
- YEAR_ADT_030
- OPEN_CLOSED_POSTED_041
- YEAR_RECONSTRUCTED_106
- SUPERSTRUCTURE_COND_059
- OPERATING_RATING_064
- years_to_sup_rating_4
- STRUCTURE_LEN_MT_049

For more information about the NBI please see https://www.fhwa.dot.gov/bridge/mtguide.cfm.

[21] USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs". Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

National Bridge Investment Analysis System (NBIAS) Condition Rating Forecasts

The NBIAS deterioration model data used for the USDOT Conditions and Performance report (C&P) was used to forecast the year each bridge will reach condition ratings of 3 and 2 for the overall bridge condition rating (or for the culvert rating in the case of culverts), and to estimate the year each bridge will reach superstructure condition rating 4. These forecasts of condition ratings are the expected condition ratings for the bridge in the no-build scenario in which no capital investments are made to improve the bridge's condition, which is consistent with the USDOT guidance for how baseline scenarios are to be constructed: "Baselines should not assume that the same (or similar) proposed improvement will be implemented later." [22] The NBIAS model used the most recent configuration from the Conditions and Performance (C&P) report using 2024 NBI data. The NBIAS model assumed a capital investment budget of $0 and assumed no maintenance spending to simulate the effects of deterioration of the bridges absent investment (to reflect the no-build scenario). Bridges were filtered from the analysis using C&P screening rules and if they were not otherwise economical to maintain over the analysis period. See the C&P methodology section for more detail on the NBIAS model. [23]

The NBIAS deterioration model estimates expected year of condition rating using NBI variables and historical data on condition rating changes. The model uses 5-year increments, and the forecasts were made over 10 periods resulting in a 50-year forecast of the bridge condition ratings. Forecasts were made for each individual element condition rating (for deck, substructure, superstructure, and culvert in the case of culverts), which was then used to determine the overall condition rating using the minimum value among the three elements (or the culvert rating in the case of culverts).

Important modeling considerations to note:

- One deterioration model was specified for each of the nine climate zones, and the climate zone was specified by county.
- Bridges that were not economical to maintain were filtered out of the analysis.
- Some bridges were filtered out of the model based on the C&P screening rules, so not all bridges may be represented in the data set.
- The assumption of no maintenance may be overly pessimistic, particularly for decks.

Additional steps were required to estimate the year of closure and the year of load posting based on the expected year of condition ratings 3 and 2.

For closures, the average number of years bridges remain at condition rating 2 before changing directly

[22] See section 3.2 Baselines and Alternatives. USDOT OST. May 13, 2025. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs". Accessed from: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance/

[23] USDOT. November 22, 2019. "Appendix B: Bridge Investment Analysis Methodology." Accessed from: https://www.fhwa.dot.gov/policy/23cpr/appendixb.cfm

to a 1 or 0 was estimated using NBI data from 1992 to 2025 (Figure 6). This estimate is meant to represent the rate of natural deterioration of bridges at condition rating 2, but because the maintenance spending cannot be observed, it may not be an unbiased reflection of deterioration. Bridges that moved from condition rating 2 to a higher condition rating, reflecting a capital investment of some kind, were excluded. The mean time to 1 or 0 from condition rating of 2 is 3.98 years using 8,301 observations of bridges from 1992 through 2025. [24]

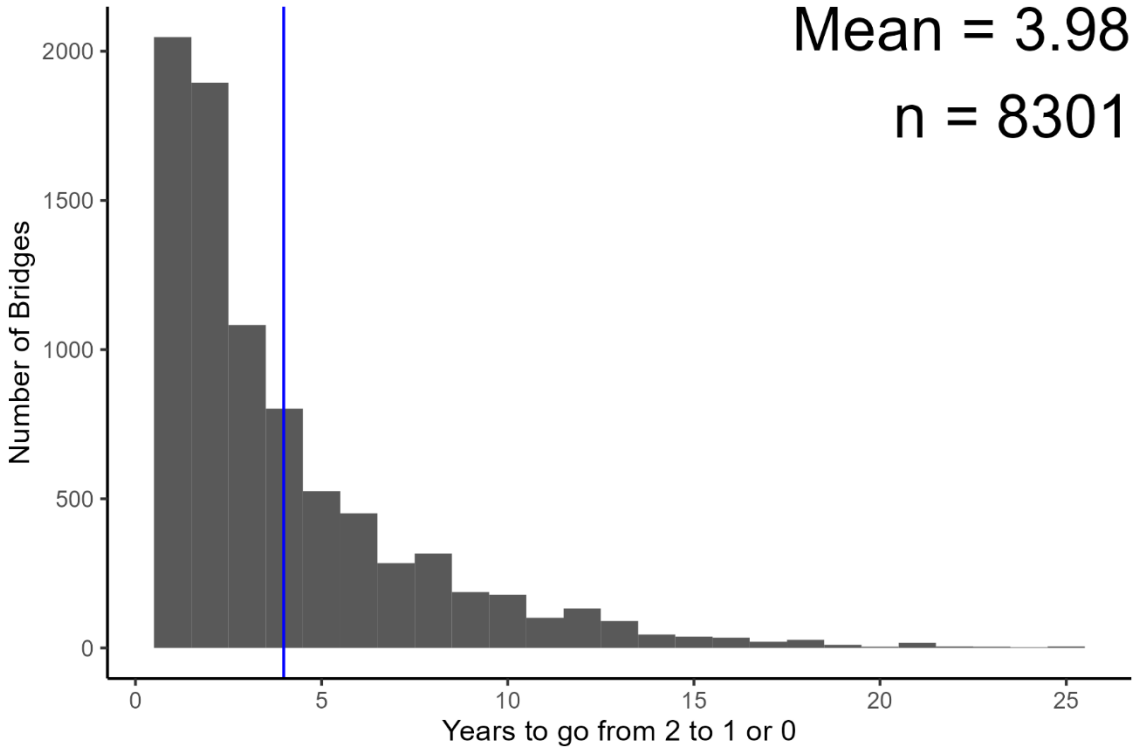

Figure 6: Histogram of Years Bridges Remain at Condition Rating 2 Before Condition Rating 1 or 0

To estimate the year of load posting, the following rules were applied based on the 2025 NBI data elements OPEN_CLOSED_POSTED_041, SUPERSTRUCTURE_COND_059, OPERATING_RATING_064, and the NBIAS forecast of superstructure condition: [25]

- If SUPERSTRUCTURE_COND_059 > 4, OPERATING_RATING_064 > 40.0, and OPEN_CLOSED_POSTED_041 = A or G, then "No Load Posting Forecasted".
- If SUPERSTRUCTURE_COND_059 > 4, OPERATING_RATING_064 <= 40.0, and OPEN_CLOSED_POSTED_041 = A or G, and NBIAS forecast of superstructure condition is 4 in a given year, then bridge is posted with 50% reduction in capacity for trucks and buses starting in

[24] Note these results were not clustered by the 9 zones as with the NBIAS model.
[25] The Operating Rating Item 64 in the NBI dataset is coded as operating rating as a 3-digit number to represent the total mass in metric tons of the entire vehicle measured to the nearest tenth of a metric ton (with an assumed decimal point). It is represented as a 2-digit number with a decimal in the tool, e.g., for example a "400" value is "40.0" in the tool.

that year.

- If SUPERSTRUCTURE_COND_059 > 4, OPERATING_RATING_064 <= 40.0, and OPEN_CLOSED_POSTED_041 = A or G, and NBIAS forecast of superstructure condition is 3 in a given year, then bridge is posted with 100% reduction in capacity for trucks and buses starting in that year.
- If SUPERSTRUCTURE_COND_059 = 4, OPERATING_RATING_064 <= 40.0, and OPEN_CLOSED_POSTED_041 = A or G, and NBIAS forecast of superstructure condition is 3 in a given year, then bridge is posted with 50% reduction in capacity for trucks and buses starting in that year.
- If OPEN_CLOSED_POSTED_041 = B, P, or R, OPERATING_RATING_064 => 36.3, SUPERSTRUCTURE_COND_059 > 4 (then assume a present 0% reduction in capacity for trucks and buses) and NBIAS forecast of superstructure condition is 4 in a given year, then bridge is posted with 50% reduction in capacity for trucks and buses starting that year; 3 in a given year then bridge is posted with 100% reduction starting in that year.
- If OPEN_CLOSED_POSTED_041 = B, P, or R, OPERATING_RATING_064 => 36.3, SUPERSTRUCTURE_COND_059 = 4 (then assume a present 50% reduction in capacity for trucks and buses) and NBIAS forecast of superstructure condition is 3 in a given year, then bridge is posted with 100% reduction in capacity for trucks and buses starting in that year.
- If OPEN_CLOSED_POSTED_041 = B, P, or R, OPERATING_RATING_064 => 36.3, SUPERSTRUCTURE_COND_059 < 4 (then assume a present 100% reduction in capacity for trucks and buses)
- If OPEN_CLOSED_POSTED_041 = B, P, or R, OPERATING_RATING_064 < 36.3, SUPERSTRUCTURE_COND_059 > 4 (then assume a present 50% reduction in capacity for trucks and buses) and NBIAS forecast of superstructure condition is 4 in a given year, then bridge is posted with 100% reduction in capacity for trucks and buses starting that year.
- If OPEN_CLOSED_POSTED_041 = B, P, or R, OPERATING_RATING_064 < 36.3, SUPERSTRUCTURE_COND_059 <= 4 (then assume a present 100% reduction in capacity for trucks and buses)

Appendix C: BCA Tool Benefit and Cost Calculation

This appendix describes the BIP BCA Tool v1.1.0 benefit and cost calculations. For each Bridge Tab Table 46–55, the columns of the table are listed with a description of the formula and the calculation methodology for each column of that table in the bulleted list below. Note: All AADT values come from Bridge Tab Table 3.

Bridge Tab Table 46: BCA Summary (Discounted)

- **Calendar Year:** The calendar year of the analysis is provided for each year, with a maximum allowable construction duration of 15 years and maximum allowable benefit period of 30 years. The calendar years begin at the first year of construction and end at the last year of the benefits period. Any row not used has the value "N/A."
- **Analysis Year:** The analysis year reflects the count of the year in the analysis with construction period ranging from -14 to 0 and the benefit period ranging from 1–30. Any row not used has the value "N/A."
- **Safety (See Table 47):** This column provides the annual and total values of the Total Safety Benefits Discounted column calculated in Bridge Tab Table 47.
- **Travel Time and Congestion (See Table 48):** This column provides the annual and total values of the Total Travel Time Benefits Discounted column calculated in Bridge Tab Table 48.
- **VOC (See Table 49):** This column provides the annual and total values of the Total VOC Benefits Discounted column calculated in Bridge Tab Table 49.
- **Resilience (See Table 50):** This column provides the annual and total values of the Total Resilience Benefits Discounted column calculated in Bridge Tab Table 50.
- **Health and Amenity (See Table 51):** This column provides the annual and total values of the Total Health and Amenity Benefits Discounted column calculated in Bridge Tab Table 51.
- **Emissions (See Table 52):** This column provides the annual and total values of the Total Emission Benefits Discounted column calculated in Bridge Tab Table 52.
- **Noise and Other Environmental (See Table 53):** This column provides the annual and total values of the Total Noise and Other Environmental Benefits Discounted column calculated in Bridge Tab Table 54.
- **Maintenance Cost Savings:** This column provides the annual O&M Cost Difference Discounted values from Bridge Tab Table 9: Capital Cost Summary. For each year, the formula is the

difference between the No-Build Annual Cost and Build Annual Cost multiplied by the annual discount factor from the 7 Discount Rate.

- **Other Quantified Benefits:** This column provides the annual Other Quantified Benefits from Bridge Tab Table 46: Additional Quantified Benefits.
- **Residual Value:** The residual value is calculated based on the USDOT BCA Guidance methodology using the inputs from Bridge Tab Table 9: Capital Cost Summary and Bridge Tab Table 10: Residual Value. For each component of the project specified in Bridge Tab Table 10, the remaining asset life is calculated as the difference of Asset Life and Years of Benefit for Analysis divided by Asset Life. This is multiplied by the Share of Capital Costs, and the annual discount factor from the 7 Discount Rate.
- **Total Benefits:** The sum of the annual and total benefits from the Safety, Travel Time and Congestion, VOC, Resilience, Health and Amenity, Emissions, Noise and Other Environmental, Maintenance Cost Savings, Other Quantified Benefits, and Residual Value columns in Bridge Tab Table 46.
- **Total Costs:** This column sums the discounted real annual costs for each year from Bridge Tab Table 7: Already Incurred Costs and Bridge Tab Table 8: Capital Costs.
- **Net Present Value:** This column calculates the annual net present value for each year.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

Bridge Tab Table 47. Annual Safety Calculations

- **Calendar Year:** The calendar years of the analysis are consistent with the Bridge Tab Table 46 Calendar Year column.
- **Analysis Year:** The analysis years are consistent with the Bridge Tab Table 46 Analysis Year column.
- **Avoided Crashes due to CMF:** The Avoided Crashes due to CMF are calculated for existing and induced drivers.
    - Existing travel component: The existing travel is converted to a percent increase in AADT as the difference of the sum of No-Build Vehicle AADT and the sum of Build Vehicle AADT divided by the Sum of Build Vehicle AADT (Bridge Tab Table 3). This is then multiplied by Total Annual Crash Costs (Bridge Tab Table 32) and the value of one minus the CMF.

- Induced travel component: The induced travel is converted to a percent increase in AADT as the difference of the sum of No-Build Vehicle AADT and the sum of Build Vehicle AADT divided by the Sum of Build Vehicle AADT (Bridge Tab Table 3) and then multiplied by one half to account for the induced demand rule of one half and multiplied by Total Annual Crash Costs (Bridge Tab Table 32) and the value of one minus the CMF.

- **Avoided Load Posting and Closure Detour Safety:** For each vehicle type and detour road type, and for load posting or closure, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), safety cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), 365 days, and the Percent of Traffic Reduced by vehicle type for load posting or closure level effective in that year (Bridge Tab Table 20 and Bridge Tab Table 21).
- **Avoided Closure Detour Safety – Intermittent:** For each vehicle type, the product of the annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the safety cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), the Days of Closure (Bridge Tab Table 22), and the Percent Reduction in All Traffic (Bridge Tab Table 22).
- **Safety Disbenefits Due to Induced Demand:** For each vehicle type, total induced detour miles traveled is calculated as the difference between No-build and Build AADT (Bridge Tab Table 3) multiplied by the detour distance (Bridge Tab Table 4) and multiplied by 365 days. This is monetized by multiplying by the safety cost per mile for the vehicle type (Defaults Tab Table A-4).
- **Construction Disbenefits Partial Capacity Safety:** The Construction Safety Disbenefits for Partial Capacity are captured as a percent increase in total annual crash costs above the baseline to represent the increase crash risk due to the construction zone. Total Annual Crash Costs (Bridge Tab Table 32: Historical Crash Data) multiplied by Percent Increase in Crashes due to Work Zone (Bridge Tab Table 14).
- **Construction Disbenefits Full Detour Safety:** For each vehicle type and for each year of construction, the product of annual vehicle AADT (Bridge Tab Table 3), the vehicle detour distance (Bridge Tab Table 4), the safety cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), the reciprocal of the external share of safety (Defaults Tab Table A-10), and days of closure during construction (Bridge Tab Table 15).
- **Total Safety Benefits:** The sum of Avoided Crashes Due to CMF, Avoided Load Posting and Closure Detour Safety Savings, Avoided Load Posting and Closure Detour Safety, Avoided

Closure Detour Safety, Construction Disbenefits Partial Capacity Safety, and Construction Disbenefits Full Detour Safety.

- **Total Safety Benefits Discounted:** The annual Total Safety Benefits multiplied by the annual discount factor from the 7 Percent Discount Rate.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

Bridge Tab Table 48. Annual Travel Time Calculations

- **Calendar Year:** The calendar years of the analysis are consistent with the Bridge Tab Table 46 Calendar Year column.
- **Analysis Year:** The analysis years are consistent with the Bridge Tab Table 46 Analysis Year column.
- **Travel Time and Mobility-Related Benefits:** The Travel Time and Mobility-Related Benefits are calculated for existing and induced drivers.
    - Existing travel component: For each vehicle type, total no-build detour miles traveled is calculated as the annual No-build AADT (Bridge Tab Table 3) multiplied by the detour distance (Bridge Tab Table 4). This product is then monetized by multiplying by average vehicle occupancy and the USDOT parameters for value of time (Bridge Tab Table 5).
    - Induced travel component: For each vehicle type, total induced detour miles traveled is calculated as the difference between No-build and Build AADT multiplied by the detour distance (Bridge Tab Table 3). It is then multiplied by one half to account for the induced demand rule of one half. This product is monetized by multiplying average vehicle occupancy (Bridge Tab Table 5) and the USDOT parameters for value of time (Bridge Tab Table 5).
- **Avoided Detour Travel Time due to Load Posting or Closures:** For each mode and detour road type, and for load posting or closure, the product of annual No-build AADT (Bridge Tab Table 3), detour distance by mode (Bridge Tab Table 4), the reciprocal of detour speed by mode, 1/60 to convert to hours, the Percent of Traffic Reduced by mode for load posting or closure level effective in that year (Bridge Tab Table 20 and Bridge Tab Table 21), and 365 days. This is monetized by multiplying by average occupancy and the USDOT parameters for value of time (Bridge Tab Table 5).
- **Avoided Detour Travel Time due to Load Posting or Closures – Intermittent:** For each mode and detour road type, and for load posting or closure, the product of annual No-build AADT

(Bridge Tab Table 3), detour distance by mode (Bridge Tab Table 4), the reciprocal of detour speed by mode, 1/60 to convert to hours, the Percent of Traffic Reduced for closure (Bridge Tab Table 22), and the number of days of closure (Bridge Tab Table 22). This is monetized by multiplying by average occupancy and the USDOT parameters for value of time (Bridge Tab Table 5).

- **Avoided Congestion Due to Avoided Load Posting or Closures:** For each vehicle type and detour road type, and for load posting or closure, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the congestion cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), 365 days, and the Percent of Traffic Reduced by vehicle type for load posting or closure level effective in that year (Bridge Tab Table 20 and Bridge Tab Table 21).
- **Avoided Congestion Due to Avoided Load Posting or Closures - Intermittent:** For each vehicle type, the product of the annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the congestion cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), the Days of Closure (Bridge Tab Table 22), and the Percent Reduction in All Traffic (Bridge Tab Table 22).
- **Congestion Disbenefits Due to Induced Demand:** For each vehicle type, total induced detour miles traveled is calculated as the difference between No-build and Build AADT (Bridge Tab Table 3) multiplied by the detour distance (Bridge Tab Table 4) and multiplied by 365 days. This is monetized by multiplying by the congestion cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10).
- **Construction Disbenefits due to Partial Capacity Travel Time:** For each mode and for each year of construction, the product of annual vehicle AADT (Bridge Tab Table 3), the detour delay time (Bridge Tab Table 14), and days of closure during construction (Bridge Tab Table 15). This product is then monetized by multiplying by average mode occupancy and the USDOT parameters for value of time (Bridge Tab Table 5).
- **Construction Disbenefits due to Full Detour Travel Time:** For each mode and for each year of construction, the product of annual vehicle AADT (Bridge Tab Table 3), the mode detour travel time (Bridge Tab Table 4), and days of closure during construction (Bridge Tab Table 15). This product is then monetized by multiplying by average occupancy and the USDOT parameters for value of time (Bridge Tab Table 5).
- **Construction Disbenefits Due to Full Detour Congestion:** Congestion construction disbenefits are only calculated for the full detour option. For each vehicle type and for each year of construction, the product of annual vehicle AADT (Bridge Tab Table 3), the vehicle detour

distance (Bridge Tab Table 4), the congestion cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10) , and days of closure during construction (Bridge Tab Table 15).

- **Total Travel Time:** The sum of Travel Time and Mobility-Related Benefits, Avoided Detour Travel Time due to Load Posting or Closures, Avoided Detour Travel Time due to Load Posting or Closures – Intermittent, Avoided Congestion due to Load Posting or Closures, Avoided Congestion due to Load Posting or Closures – Intermittent, Congestion Disbenefits Due to Induced Demand, Construction Disbenefits due to Partial Capacity Travel Time, Construction Disbenefits due to Full Detour Travel Time, and Construction Disbenefits due to Full Detour Congestion.
- **Total Travel Time Discounted:** The annual Total Travel Time multiplied by the annual discount factor from the 7 Percent Discount Rate.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

Bridge Tab Table 49: Annual VOC Calculations

- **Calendar Year:** The calendar years of the analysis are consistent with the Bridge Tab Table 46 Calendar Year column.
- **Analysis Year:** The analysis years are consistent with the Bridge Tab Table 46 Analysis Year column.
- **Avoided Detour VOC due to Load Posting or Closures:** For each vehicle type and detour road type, and for load posting or closure, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), VOC cost per mile for the detour road type and vehicle type (Defaults Tab Table A-4), 365 days, and the Percent of Traffic Reduced by vehicle type for load posting or closure level effective in that year (Bridge Tab Table 20 and Bridge Tab Table 21).
- **Avoided Detour VOC due to Load Posting or Closures – Intermittent:** For each vehicle type, the product of the annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the VOC cost per mile for the detour road type and vehicle type (Defaults Tab Table A-4), the Days of Closure (Bridge Tab Table 22), and the Percent Reduction in All Traffic (Bridge Tab Table 22).
- **VOC Disbenefits Due to Induced Demand:** For each vehicle type, total induced detour miles traveled per year is calculated as the product of the difference between No-build and Build

AADT (Bridge Tab Table 3), the detour distance (Bridge Tab Table 4) and 365 days. This is monetized by multiplying by the VOC cost per mile for the vehicle type (Defaults Tab Table A-4).

- **Construction Disbenefits Full Detour VOC:** VOC Construction disbenefits are only calculated for the full detour option. For each vehicle type and for each year of construction, the product of annual vehicle AADT (Bridge Tab Table 3), the vehicle detour distance (Bridge Tab Table 4), the VOC cost per mile for the detour road type and vehicle type (Defaults Tab Table A-4) , and days of closure during construction (Bridge Tab Table 15).
- **Total VOC Benefits:** The sum of Avoided Detour VOC due to Load Posting or Closures, Avoided Detour VOC due to Load Posting or Closures – Intermittent, VOC Disbenefits Due to Induced Demand, Construction Disbenefits Full Detour VOC.
- **Total VOC Benefits Discounted:** The annual Total VOC Benefits multiplied by the annual discount factor from the 7 Percent Discount Rate.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

Bridge Tab Table 50: Annual Resilience Calculations

- **Calendar Year:** The calendar years of the analysis are consistent with the Bridge Tab Table 46 Calendar Year column.
- **Analysis Year:** The analysis years are consistent with the Bridge Tab Table 46 Analysis Year column.
- **Avoided Maintenance/Repair/Operation Costs:** For each hazard event, the difference of the Maintenance/Repair/Operation costs in the No-build and Build scenarios (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). This annual figure is then multiplied by the annual hazard risk for the scenario level.
- **Avoided Fatalities and Injuries Due to Larger Structural Damage:** For the Larger Structural Damage scenario, the difference of the Fatality and Injuries in the No-build and Build scenarios (Bridge Tab Table 28). This annual figure is then multiplied by the annual hazard risk for the scenario level.
- **Avoided Detour Travel Time Costs:** For each vehicle type and detour road type, and for each level of hazard event, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour travel time (Bridge Tab Table 4), the difference in days of closure in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28), and the difference in the share of traffic reduced in the Build and No-build scenario (Bridge Tab Table 26,

Bridge Tab Table 27, and Bridge Tab Table 28). This product is then monetized by multiplying by average vehicle occupancy and the USDOT parameters for value of time (Bridge Tab Table 5). This annual figure is then multiplied by the annual hazard risk for the scenario level.

- **Avoided Detour Pedestrian and Bicyclists Travel Time:** For each mode, and for each level of hazard event, the product of annual No-build vehicle AADT (Bridge Tab Table 3), detour travel time (Bridge Tab Table 4), the difference in days of closure in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28), and the difference in the share of traffic reduced in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). This product is then monetized by the USDOT parameters for value of time (Bridge Tab Table 5). This annual figure is then multiplied by the annual hazard risk for the scenario level.
- **Avoided Detour Vehicle Operating Costs:** For each vehicle type and detour road type, and for each level of hazard event, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance(Bridge Tab Table 4), the VOC cost per mile (Defaults Tab Table A-4), the difference in days of closure in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28), and the difference in the share of traffic reduced in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). This annual figure is then multiplied by the annual hazard risk for the scenario level.
- **Avoided Detour Safety:** For each vehicle type and detour road type, and for each level of hazard event, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the safety cost per mile (Defaults Tab Table A-10), the difference in days of closure in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28), and the difference in the share of traffic reduced in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). This annual figure is then multiplied by the annual hazard risk for the scenario level.
- **Avoided Detour Noise:** For each vehicle type and detour road type, and for each level of hazard event, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the noise cost per mile (Defaults Tab Table A-10), the difference in days of closure in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28), and the difference in the share of traffic reduced in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). This annual figure is then multiplied by the annual hazard risk for the scenario level.
- **Avoided Detour Congestion:** For each vehicle type and detour road type, and for each level of hazard event, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour

distance (Bridge Tab Table 4), the congestion cost per mile (Defaults Tab Table A-10), the difference in days of closure in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28), and the difference in the share of traffic reduced in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). This annual figure is then multiplied by the annual hazard risk for the scenario level.

- **Avoided Detour Emissions:** For each vehicle type and detour road type, and for each level of hazard event, the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the emissions cost per mile (Defaults Tab Table A-10), the difference in days of closure in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28), and the difference in the share of traffic reduced in the Build and No-build scenario (Bridge Tab Table 26, Bridge Tab Table 27, and Bridge Tab Table 28). This annual figure is then multiplied by the annual hazard risk for the scenario level.
- **Total Resilience Benefits:** The sum of Avoided Maintenance/Repair/Operation Costs, Avoided Fatalities and Injuries Due to Larger Structural Damage, Avoided Detour Travel Time Costs, Avoided Detour Pedestrian and Bicyclists Travel Time, Avoided Detour Vehicle Operating Costs, Avoided Detour Safety, Avoided Detour Noise, Avoided Detour Congestion, and Avoided Detour Emissions.
- **Total Resilience Benefits Discounted:** The sum of Avoided Maintenance/Repair/Operation Costs, Avoided Fatalities and Injuries Due to Larger Structural Damage, Avoided Detour Travel Time Costs, Avoided Detour Pedestrian and Bicyclists Travel Time, Avoided Detour Vehicle Operating Costs, Avoided Detour Safety, Avoided Detour Noise, Avoided Detour Congestion, and Avoided Detour Emissions multiplied by the annual discount factor for the 7 Percent Discount Rate.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

Bridge Tab Table 51: Annual Health and Amenity Calculations

- **Calendar Year:** The calendar years of the analysis are consistent with the Bridge Tab Table 46 Calendar Year column.
- **Analysis Year:** The analysis years are consistent with the Bridge Tab Table 46 Analysis Year column.
- **Mortality Reduction Benefits:** For each mode, the annual induced trips are calculated as the annual build AADT minus the No-build AADT (Bridge Tab Table 3). The annual induced trips are

then multiplied by Mortality Reduction Benefits Age Adjustment percentages (Defaults Tab Table A-9b) and the Trips Induced from Non-active modes (Bridge Tab Table 43), and then annualized at 365 days. These are monetized using the Mortality Reduction Benefits of Induced Active Transportation Values (Defaults Tab Table A-9b).

- **Pedestrian Facility Improvement Benefits:** Benefits are calculated for existing and induced travel. The Annual Weighted Pedestrian AADT is calculated as annual No-build AADT (existing) plus one half multiplied by the difference of annual Build AADT and annual No-build AADT (induced) (Bridge Tab Table 3), to account for existing travel and the rule of one half for induced travel. This is then multiplied by the trips induced from non-active modes (Bridge Tab Table 42).
    - **Marked Crosswalks:** In areas with greater than 10,000 AADT, the total annual uses for marked crosswalks is calculated as pedestrian AADT, reduced for the number of crossings per trip, multiplied by the number of installed marked crosswalks (Bridge Tab Table 42), and annualized at 365 days. This is monetized by the dollar value of installing marked crosswalks on roadway (Defaults Tab Table A-7b).
    - **Pedestrian Signals:** In areas with greater than 13,000 AADT, the total annual uses for pedestrian signals is calculated as pedestrian AADT, reduced for the number of uses per trip, multiplied by the number of installed signals for pedestrian crossings on roadway (Bridge Tab Table 42), and annualized at 365 days. This is monetized by the dollar value for installing a signal for pedestrian crossing on roadways (Defaults Tab Table A-7b).
    - **Sidewalk Width:** The product of annual weighted pedestrian AADT (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value for expanding sidewalk width per foot (Defaults Tab Table A-7a).
    - **Reduce Upslope:** The product of annual weighted pedestrian AADT, reduced upslope percentage (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value of the reduced upslope by 1 percent factor (Defaults Tab Table A-7a).
    - **Reduce Traffic Speed:** The product of annual weighted pedestrian AADT, reduced traffic (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value for reducing speed by 1 mile per hour (Defaults Tab Table A-7a).
    - **Reduce Traffic Volume:** The product of annual weighted pedestrian AADT, reduced traffic speed miles per hour (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value of reducing traffic speed by 1 vehicle per hour (Defaults Tab Table A-7a), divided by 24 hours.
- **Cycling Facility Improvement Benefits:** Benefits are calculated for existing and induced travel. The Annual Weighted Cycling AADT is calculated as annual No-build AADT (existing) plus one

half multiplied by the difference of annual Build AADT and annual No-build AADT (induced) (Bridge Tab Table 3), to account for existing travel and the rule of one half for induced travel, multiplied by the trips induced from non-active modes (Bridge Tab Table 42).

    - **Cycling Path with At-Grade Crossings:** The product of annual weighted cycling AADT, the miles of impacted length (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value of adding a Cycling Path with At-Grade Crossings (Defaults Tab Table A-8).
    - **Cycling Path with no At-Grade Crossings:** The product of annual weighted cycling AADT, the miles of impacted length (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value of adding a Cycling Path with no At-Grade Crossings (Defaults Tab Table A-8).
    - **Dedicated Cycling Lane:** The product of annual weighted cycling AADT, the miles of impacted length (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value of adding a Dedicated Cycling Lane (Defaults Tab Table A-8).
    - **Cycling Boulevard/Sharrow:** The product of annual weighted cycling AADT, the miles of impacted length (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value of adding a Cycling Path with At-Grade Crossings (Defaults Tab Table A-8).
    - **Separated Cycle Track:** The product of annual weighted cycling AADT, the miles of impacted length (Bridge Tab Table 42), and 365 days. This is monetized by the dollar value of adding a Separated Cycle Track (Defaults Tab Table A-8).

- **Total Health and Amenity Benefits:** The sum of Mortality Reduction Benefits, Pedestrian Facility Improvement Benefits, Cycling Facility Improvement Benefits, and Total Health and Amenity Benefits.
- **Total Health and Amenity Benefits Discounted:** Total Health and Amenity Benefits multiplied by the annual discount factor from the 7 Percent Discount Rate.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

Bridge Tab Table 52: Annual Calculations

- **Calendar Year:** The calendar years of the analysis are consistent with the Bridge Tab Table 46 Calendar Year column.
- **Analysis Year:** The analysis years are consistent with the Bridge Tab Table 46 Analysis Year column.

- **Emission benefits due to avoided load posting and closure:** For each vehicle type and detour road type, and for load posting or closure, the total emissions cost per year is calculated as the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), emissions cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), and 365 days. The annual benefits are then calculated by multiplying by the Percent of Traffic Reduced by vehicle type for load posting or closure level effective in that year (Bridge Tab Table 20 and Bridge Tab Table 21).
- **Emission benefits due to avoided load posting and closure -intermittent:** For each vehicle type, the product of the annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the emissions cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), the Days of Closure (Bridge Tab Table 22), and the Percent Reduction in All Traffic (Bridge Tab Table 22).
- **Emission Disbenefits due to Induced Demand:** For each vehicle type, total induced detour miles traveled per year is calculated as the product of the difference between No-build and Build AADT (Bridge Tab Table 3), the detour distance (Bridge Tab Table 4) and 365 days. This is monetized by multiplying by the emissions cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10).
- **Emission Construction Disbenefits:** Emission construction disbenefits are only calculated for the full detour option. For each vehicle type and for each year of construction, the product of annual vehicle AADT (Bridge Tab Table 3), the vehicle detour distance (Bridge Tab Table 4), the emissions cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), and days of closure during construction (Bridge Tab Table 15).
- **Total Emission Benefits:** The sum of emission benefits due to avoided load posting and closure, emission benefits due to avoided load posting and closure -intermittent, Emission Disbenefits due to Induced Demand, and Emission Construction Disbenefits.
- **Total Emission Benefits Discounted:** The annual Total Emission Benefits multiplied by the annual discount factor from the 7 Percent Discount Rate.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

Bridge Tab Table 53: Annual Noise and Other Environmental Calculations

- **Calendar Year:** The calendar years are consistent with the Bridge Tab Table 46 Calendar Year column.

- **Analysis Year:** The analysis years are consistent with the Bridge Tab Table 46 Analysis Year column.
- **Noise Benefits due to avoided Load Posting or Closures:** For each vehicle type and detour road type, and for load posting or closure, total noise cost per year is calculated as the product of annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), noise cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), and 365 days. The total benefit is then calculated by multiplying by the Percent of Traffic Reduced by vehicle type for load posting or closure level effective in that year (Bridge Tab Table 20 and Bridge Tab Table 21).
- **Noise Benefits due to avoided Load Posting or Closures - Intermittent:** For each vehicle type, the product of the annual No-build vehicle AADT (Bridge Tab Table 3), vehicle detour distance (Bridge Tab Table 4), the noise cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10), the Days of Closure (Bridge Tab Table 22), and the Percent Reduction in All Traffic (Bridge Tab Table 22).
- **Noise disbenefits due to Induced Demand:** For each vehicle type, total induced detour miles traveled per year is calculated as the product of the difference between No-build and Build AADT (Bridge Tab Table 3),the detour distance (Bridge Tab Table 4) and 365 days. This is monetized by multiplying by the noise cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10).
- **Noise Construction Disbenefits:** Noise Construction disbenefits are only calculated for the full detour option. For each vehicle type and for each year of construction, the product of annual vehicle AADT (Bridge Tab Table 3), the vehicle detour distance (Bridge Tab Table 4), the noise cost per mile for the detour road type and vehicle type (Defaults Tab Table A-10) , and days of closure during construction (Bridge Tab Table 15).
- **Other Environmental Benefits:** For each category (wildlife connectivity, noise, and water runoff), the Annual Benefit in the Initial Year (Bridge Tab Table 40) multiplied by the annual growth rate factor, which is calculated as the sum of 1 and the Annual Growth Rate (Bridge Tab Table 40) raised to the Calendar Year minus 1.
- **Total Noise and Other Environmental Benefits:** The sum of Noise Benefits due to avoided Load Posting or Closures, Noise Benefits due to avoided Load Posting or Closures – Intermittent, Noise disbenefits due to induced demand, Noise Construction Disbenefits, and Other Environmental Benefits.

- **Total Noise and Other Environmental Benefits Discounted:** The annual Total Noise and Other Environmental Benefits multiplied by the annual discount factor from the 7 Percent Discount Rate.
- **7 Percent Discount Rate:** Provides the annual discount factor for the 7 percent discount rate from Bridge Tab Table 47.

U.S. Department of Transportation
John A. Volpe National Transportation Systems Center
220 Binney Street
Cambridge, MA 02142-1093

617-494-2000
www.volpe.dot.gov