

MEMORANDUM

ALLIGATOR RIVER BRIDGE REPLACEMENT PROJECT BENEFIT-COST ANALYSIS

Introduction

Benefit-Cost Analysis (BCA) is a systematic process for identifying, quantifying, and comparing expected benefits and costs of a potential infrastructure project. A BCA provides estimates of the anticipated benefits that are expected to accrue from a project over a specified period and compares them to the anticipated costs of the project. Costs include both the resources required to develop the project and the costs of maintaining the new or improved asset over time. Estimated benefits are based on the projected effects of the project on both users of the facility and non-users, valued in monetary terms.¹

In seeking a USDOT Multimodal Project Discretionary Grant (MPDG) for its Alligator River Bridge Replacement Project, the North Carolina Department of Transportation (NCDOT) prepared a BCA as part of its Grant application package. This memorandum describes the method used to conduct the BCA and presents a summary of its findings.

Project Description

The Alligator River Bridge Replacement Project (the Project) will replace the existing US 64 swing-span bridge crossing the Alligator River with a high-level fixed-span bridge that would no longer require the delay of automobiles while marine vessels travel through the Intercoastal Waterway.

BCA Methodology

The Project's BCA was conducted according to the USDOT's 2022 guidance document.² Costs that were monetized included initial capital costs, roadway operating costs, and maintenance costs. Benefits that were monetized included safety improvements, various user and non-user benefits (including reduced travel time and operating costs), and environmental benefits (such as improved air quality). The present value of all benefits and costs was calculated using 2020 dollars.

The USDOT Guidance identifies four overall values for consideration: benefits, costs, benefit-cost ratio (BCR), and net present value. Each of these are reported undiscounted and with a 7% discount.

Analysis Period

¹ USDOT. Benefit-Cost Analysis Guidance for Discretionary Grant Programs. 2022 (Revised).

² Ibid.

The Project's BCA analysis covers a 30-year time period, beginning in 2022. This includes the time required for the Project's construction and a period of time following construction during which the Project's benefits will accrue. This time frame was based on the current (May 2022) Project schedule and associated construction duration assumptions. This assumes construction beginning in 2024 and completed by end of calendar year 2026.

Traffic Volume Forecasts

Traffic volume forecasts used in the BCA were obtained from the *R-2544 and R-2545 Traffic Estimate* developed by the NCDOT Transportation Planning Division. The estimate has a Base Year of 2016 and Future Year of 2045. Interpolation and extrapolation were used to obtain other traffic volumes for intermediate and post-2045 years. The project is not expected to increase traffic volumes in the area. Therefore, the same volumes were used in the No-Build and Build scenarios.

Economic Values

Key inputs, including the value of time, cost of crashes, vehicle operating costs, and cost of pollutant emissions, were obtained from the USDOT's 2022 Guidance document.

Operating and Maintenance Cost

Inputs for operating and maintenance (O&M) and rehabilitation and replacement (R&R) costs, were obtained from the NCDOT Structures Management Unit.

Travel Time and Operating Cost

The Project will result in an overall reduction in vehicle miles traveled (VMT) and vehicle hours traveled (VHT) and will therefore decrease travel time and user operating costs. These annual travel time and operating costs savings were calculated for both non-commercial and commercial vehicles. Other assumptions were based on the 2022 USDOT guidance, including the value of time for non-commercial and commercial vehicles and average vehicle occupancy (1.67 passengers per vehicle for noncommercial vehicles). Given the heavy vacation and recreational nature of traffic using the Alligator River Bridge project, the vehicle occupancy rate of 1.67 for non-commercial traffic may be low and therefore under quantifying the benefits derived.

The VHT savings are based on the delay experienced both when the existing bridge is open to allow marine vessels to pass through and when the existing bridge is closed for maintenance (scheduled and damage repair), resulting in an approximate 90-mile detour route. These closure times were provided by the US Coast Guard and NCDOT respectively. The VMT savings are based on the elimination of the required detour route when the existing bridge is closed for maintenance.

The VHT savings were also used to calculate fuel cost savings, using idle fuel consumption and current average fuel costs. Annual VMT savings were used to calculate cost savings related to reduced vehicle wear and tear. Reduced VMT

savings were calculated for both non-commercial and commercial vehicles using data from the TRM, and vehicle operating costs from USDOT 2022 guidance.

Environmental Impacts

The overall reduction in VMT achieved as a result of the Project will reduce overall tailpipe emissions. The EPA's average in-use emission rates for passenger cars and heavy trucks, and USDOT's damage costs for pollutant emissions, were used to calculate the savings. Damage costs for Volatile Organic Compounds (VOC) were also calculated, based on FHWA documentation.

Safety Analysis

The Project's safety analysis was done using two separate approaches. Crash totals from the existing bridge were obtained from the NCDOT Traffic Safety Unit. Crashes related to the bridge being closed for marine vessels and those associated with the bridge tender were assumed to be completely eliminated. A crash reduction factor related to the widening of the bridge shoulders was applied to the other remaining crashes.

Hurricane Evacuation

US 64 serves as a hurricane evacuation route for those leaving the Outer Banks. The Project will reduce evacuation times by 4.2 hours over a 36-hour evacuation period. Based on historic trends and the current/projected increased frequency and strength of hurricanes, it was assumed that two evacuations would occur per year.

Broadband/ITS

The Project also involves including broadband fiber from I-95 to NC 12. The inclusion of ITS projects such as variable message signs was included in the Project cost estimate. The NCDOT Traffic Safety Unit has a crash reduction factor of five percent for installing such ITS devices. The total number of crashes for the 140-mile corridor was provided by the Traffic Safety Unit. These crashes (minus the ones directly related to the existing bridge) were then reduced by three percent for a conservative analysis to calculate the savings from the reduced crashes.

BCA FINDINGS

The findings of the Project's benefit-cost analysis are summarized in the table on the following page. Detailed findings are contained in a multi-tab spreadsheet, included as a separate attachment to the MPDG Application.

The first tab of the spreadsheet is the summary presented below, showing the results of the analysis. The next tab is the Summary Table, including all the annual costs and calculations of the BCA results. The remaining tabs provide inputs and assumptions and calculate the individual costs and benefits, including construction costs, safety impacts, travel time and operating cost savings, and others.

Project Costs	Project Costs (NPV)	Total Net Benefits	Total Net Benefits (NPV)	Benefit-Cost Ratio
\$294,600,000	\$171,189,968	\$483,350,763	\$256,011,394	1.50

Notes on this table:

- The Project's cost is estimated to be \$294.6M undiscounted and \$171.2M using a 7% discount rate. 2027 is the first full year that benefits from the project will begin.

Factors Not Quantified

In addition to the quantified benefits reported above, other benefits that do not lend themselves to being quantified but are nonetheless achieved by the Project were also identified. These included: economic competitiveness, infrastructure kept in a state of good repair, and resiliency.