

Benefit-Cost Analysis Narrative

Executive Summary

The North Carolina Department of Transportation (NCDOT) is submitting a Benefit-Cost Analysis (BCA) for the construction phase of the Franklin 99 Bridge Resilience Improvement Project (Project) as part of its application for the PROTECT grant program from the U.S. Department of Transportation (USDOT). The BCA, conducted using USDOT's BCA Spreadsheet Template, assumes that the project will generate substantial benefits across multiple categories, resulting in a robust benefit-cost ratio.

Key benefits of the Bridge replacement include:

1. **Vulnerability and Risk:** The bridge's structural integrity is in a critical state of decline, as referenced in recent inspection reports. The project will reconstruct the structure at a new location downstream of its current location on Crooked Creek, thus reducing risk of structural failure.
2. **Safety:** The project will provide a shorter route for vehicles to travel between Clifton Pond Road/Mc Wilder Road and NC-98, thereby significantly reducing the number of possible collisions.
3. **Resilience:** Replacing the existing bridge will avoid lengthy closures and repairs associated with prolonged wear and tear on a nearly 60-year-old structure.
4. **Criticality to American Families and Communities:** Travel time will be reduced for community members looking to access amenities near Clifton Pond Road, such as Triangle North Executive Airport, leading to an overall increase in quality of life.

The BCA leverages detailed collision records, historical bridge condition data, and local mode-share information to quantify the project's benefits and costs over a 30-year analysis period. With a Benefit-Cost Ratio (BCR) of 5.02 and total discounted benefits of \$30,812,945 and a net present value of \$24,673,501, the Franklin 99 bridge reconstruction project offers a compelling investment opportunity addressing vulnerability and risk, criticality to surrounding communities, and resilience through innovative design and infrastructure elements.

Benefit-Cost Analysis

This narrative summarizes the strategies, assumptions, and outstanding data needs that will be utilized in the calculation of the Benefit-Cost Ratio for the Franklin 99 Bridge Resilience Improvement Project as part of an application for funding to the federal PROTECT grant program.

This analysis was performed in accordance with the “Benefit-Cost Analysis Guidance for Discretionary Grant Programs” published by USDOT in December 2025. Additionally, the process will heavily utilize the Department’s BCA Spreadsheet Template, last updated on December 23, 2025. These resources include numerous economic benefit reference values that have been vetted by USDOT, but analysts are also permitted to use values found elsewhere if cited and sourced from a reputable organization.

Table 1: Summary of Project Benefits Build Scenario

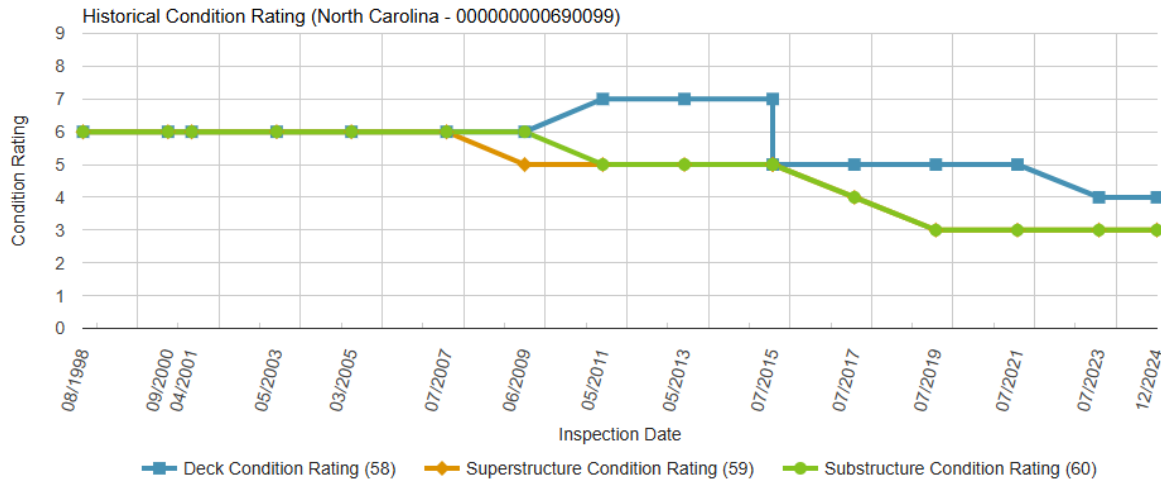
Benefit Category	No-Build Condition	Build Condition	Benefit Captured
Safety	Traffic remains distributed across detour routes with higher exposure.	Traffic returns to the improved bridge corridor.	Avoided crash costs.
Travel Time	Users remain on longer detour routes.	Users return to the direct bridge route.	Avoided vehicle-hours of delay.
Vehicle Operating Costs	Vehicles travel excess detour miles.	Trips use a shorter direct connection.	Avoided vehicle operating costs.
Emissions	Longer detours increase VMT.	Reduced VMT lowers emissions.	Avoided emissions costs.
Road Congestion and Noise Costs	Longer detours increase costs associated with congestion and road noise.	Trips use a shorter direct connection.	Avoided congestion and noise costs.
Resilience	Bridge currently at high structural risk.	Reconstruct bridge with newer materials.	Avoided repair costs, costs associated with bridge closures.

Existing Bridge Condition

According to routine bridge inspection records dated January 2025-2026, the Franklin 99 bridge received a condition score of 4 (Poor Condition) for the bridge deck, as well as a score of 3 (Poor Condition) for the bridge superstructure and substructure ([Attachment L – Bridge Inspection Reports](#)). At the same time, the adjacent Clifton Pond Dam (located upstream along Crooked Creek from the bridge) has been noted in a March 2024 technical report as experiencing water seepage and vegetation growth ([Attachment E – Bridge Removal or Closure Evaluation](#)). Water

flow from the collapse of this over 100-year-old dam has the potential to seriously weaken the integrity of the Franklin 99 bridge, leading to permanent closure. **Table 2** below illustrates the recent decline in condition rating from Good to Fair (7-5) to Poor (4-3) across all bridge components, per National Bridge Inventory (NBI) condition rating data.

Table 2: Historical Condition Ratings of Franklin 99 Bridge



Build vs. No-Build Conditions

Benefit-Cost Analysis requires a clear and consistent distinction between a Build and a No-Build scenario. For the Franklin 99 bridge, the Build scenario is presumed to be one in which:

- The existing bridge is removed and reconstructed at a new downstream location, opening in 2033 after 18 months of construction.
- During the construction period, traffic is temporarily diverted along a detour stretching along NC 98, Tarboro Road, Louisburg Road, and Clifton Pond Road.

A No-Build scenario is one in which:

- The existing bridge is demolished due to condition and risk within one year of this BCA submittal (2027).
- Affected bridge users must permanently rely on the detour route stretching along NC-98, Tarboro Road, Louisburg Road, and Clifton Pond Road/McWilder Road to travel north-south across Crooked Creek.

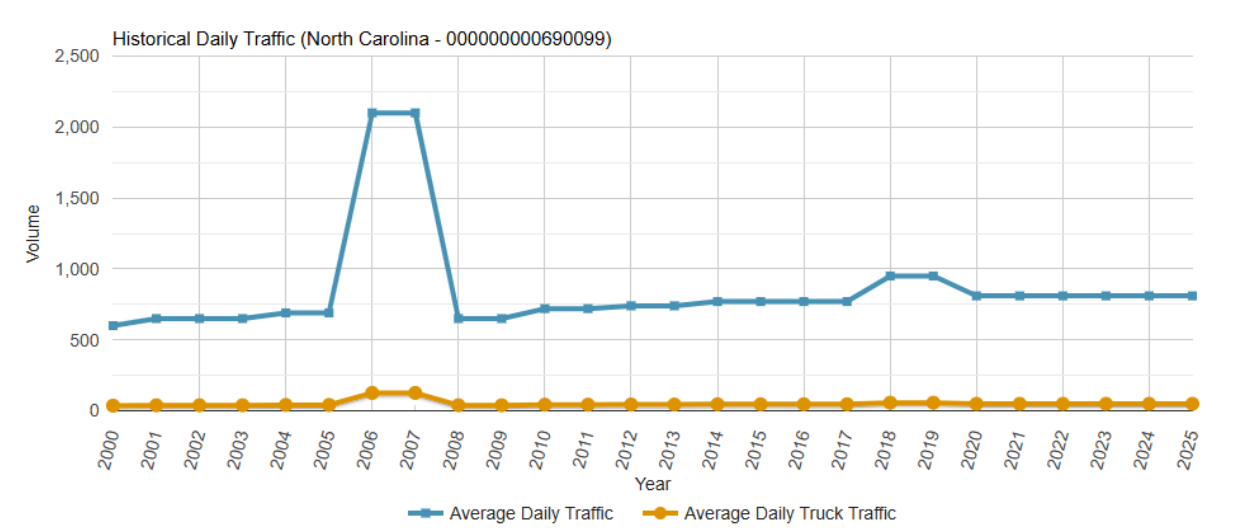
The term “cost” is often used in varying contexts. All costs are expressed in a dollar amount, but could vary from being a direct expenditure (such as a project’s construction cost), an estimated gradual expenditure imposed or avoided on another person (such as the cost imposed by the use of their personal vehicle), or a value converted from a non-monetary value, such as a person’s travel time, health, or injury (or lack thereof). Only direct project construction is considered part

of the “Cost” side of a Benefit-Cost Ratio. For all other costs, the difference between Build and No-Build cost is calculated, with the net difference considered a “Benefit” in the context of Benefit-Cost Ratio. Therefore, avoided non-construction costs are “Benefits,” and imposed non-construction costs are “Negative Benefits.”

Vehicle Volumes

To ensure consistent and defensible benefit calculation, vehicle volumes must be projected for the 30-year benefit window; these assumptions are used consistently for all subsequent calculations, including detour assumptions and safety assumptions. NBI’s data set identified Franklin 99 as carrying an estimated volume of 810 vehicles per day in 2025 (see [Table 3](#) below).

Table 3: NBI Historical Daily Traffic



Ambient Growth Rate

The National Bridge Inventory (NBI) makes the following assumptions of the Franklin 99 bridge: 810 trips in 2025 and 1,620 daily trips in 2040. These assumptions correspond to a 4.73% annual growth rate. While the immediate vicinity of the Franklin 99 bridge is rural, its proximity to the nearby growing town of Wake Forest necessitates improvements to the bridge’s structural integrity so that higher vehicle loads can be carried. A planned expansion to the Triangle North Executive Airport also implies the need for an improved bridge at this location, given Clifton Road’s status as a connector between the airport and NC-98. Furthermore, new industrial development planned near the project site, including a 545-acre light manufacturing development proposed at the intersection of Clifton Pond Road/McWilder Road, indicates a need for resilient structures that will support increases in commercial traffic.

Pedestrian and Bike Volumes

Currently no pedestrian and bike volumes are identified along the bridge, as no pedestrian or bike infrastructure exists on the current route. However, the future bridge will include wider road shoulders in its design, allowing room for pedestrians and cyclists to safely travel. Thus, a 2% percent factor of each year’s vehicle volumes is applied to estimate future pedestrian and bike volumes.

Truck Volumes

This Project also includes some benefits for truck traffic, as NBI tracks 6% of existing volumes as truck volumes. While the original bridge enforces an axle weight limit of 6.5 tons, trucks still utilize this connection for various reasons, such as a connector between NC-98 and Triangle North Executive Airport. As such, truck volumes are also projected to increase within the 30-year period as Holly Springs continues to develop.

Project Construction and Capital Costs

Construction costs and timelines are based on assumptions outlined in [Table 4](#) below. A more comprehensive outline of these costs can be found in the budget narrative.

Table 4: Timeline of Construction Costs

Year	Total Anticipated Cost
2032	\$7,581,535
2033	\$6,371,518

Operations and Maintenance

This BCA assumes a No-Build demolition cost of \$207,360 once the bridge is closed due to poor structural inspection ratings (assumed to be the year 2027). Operations and maintenance costs included in this BCA for the Build scenario reflect a combination of bridge closure costs and general maintenance and repair costs. Costs relating to increased travel time, vehicle operations, emissions, and highway externalities resulting from a potential bridge closure are calculated in the Operations and Maintenance tab of the BCA Calculations Workbook and reflect an assumed one-day closure occurring every two years due to crashes or outlying circumstances. The frequency of collision-related closures is based on collisions recorded within 500 feet of the bridge site between 2013 and 2023 (Attachment M - Bridge Crash Analysis). Aside from closures, expected 10-year, 20-year, and 30-year cycle maintenance costs were also included; the source of these numbers are identified in the O&M tab in the BCA Calculations Workbook.

External Environmental Event Costs

Often a BCA will consider the reduction in costs associated with extreme environmental events, such as damage and closures caused by extreme flooding that is observable when comparing the Build scenario to the No-Build scenario.

While an unlikely event, the Build Scenario incorporates maintenance costs to prepare for the effects of a 500-year flood that may strike Crooked Creek. This is to reflect the resiliency of the bridge in the face of an extreme weather hazard. With general FEMA assumptions and guidance, annual probabilities of 0.2% are assumed/calculated for the likelihood of a 500-year flood occurring during the BCA analysis period. These probabilities were then utilized in developing annual potential repair costs associated with each event, as well as costs associated with closing the improved bridge to through traffic for one day while repairs occur. These costs are respectively included in the Operations and Maintenance tab located in the BCA calculation worksheet.

Vehicle Detouring

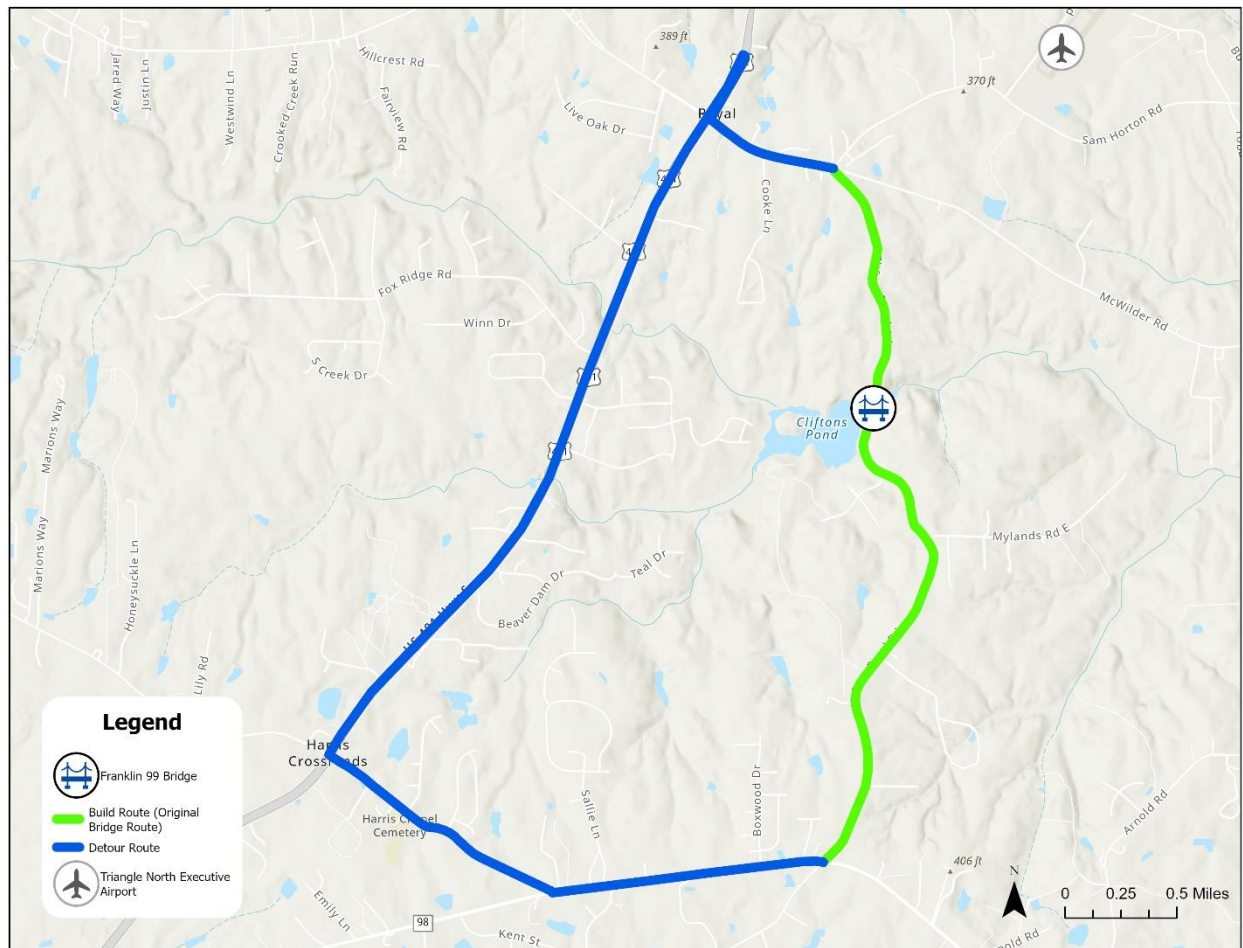
The project Build scenario is expected to substantially shorten vehicle trips when compared to the No-Build scenario, particularly due to the No-Build scenario containing the complete decommissioning of the bridge by 2027. Upon a comprehensive review of existing traffic conditions, one major detour route has been identified:

Table 5: Summary of Bridge Detours

Detour	Assumed Share	Added Distance	Added Travel Time	Source/Justification
Clifton Pond Road-McWilder Road/Louisburg Road/Tarboro Road/NC-98	100%	5.1 miles (NB) 5.7 miles (SB)	2.3 minutes (NB) 2.9 minutes (SB)	Observed congestion/travel time patterns.

A map displaying both the northbound and southbound detour can be found on the following page in [Figure 1](#).

Figure 1: Primary Detours During Closure



Safety Benefits

Traffic safety is a crucial element in driving forward project benefits. Cost values recommended by USDOT and assigned to each level of collision severity were used to calculate the cost difference between the No Build and Build scenarios. These values are located in the Safety tab of the BCA Calculations Workbook.

This cost difference was calculated by first identifying the number of intersection and roadway segment collisions that occurred on the detour route over a six-year period (2020-2025) using NCDOT's Traffic Safety Unit crash database. Links to the intersection and segment crash databases are found in the Safety tab of the BCA Calculations Workbook. Collisions occurring on a "Build scenario" route where the bridge is assumed to be improved and open were also collected over the same period using the same source.

Calculation of Five-Year VMT Along Detour Routes

The second step in the safety benefits calculation process was determining the total five-year identified detour consisted of 4 segments of existing roadways, with the segments coded as such:

Table 6: Bridge Detour Route Segments

A	NC-98 from Clifton Pond Rd to Tarboro Rd
B	Tarboro Rd from NC-98 to Louisburg Road
C	Louisburg Road from Tarboro Rd to McWilder Road/Clifton Pond Road
D	McWilder Road/Clifton Pond Road from Louisburg Road to Clifton Pond Road

For each segment, the overall objective is to determine the total five-year VMT (which is calculated by multiplying vehicle volumes by segment length). Thus, the total six-year VMT for each detour route is calculated by summing the six-year VMT of its segments. Detailed counts data were obtained through NCDOT's AADT web map. Links to the AADT web map may also be found in the Safety Tab of the BCA Calculations Workbook.

Finally, these volumes were multiplied by the segment length, then adjusted to reflect five-year VMT rather than daily VMT, providing a singular number that represents the detour VMT over the five years for the purposes of BCA calculations. The VMT was then incorporated into the collision rate calculation.

Calculation of Collision Rates

Collision rates per million vehicle miles (MVMT) were subsequently calculated for each collision type/severity level along each detour route and the "Build scenario" route for each of the six study years. These rates are displayed in the series of tables below, along with the number of collisions recorded on each detour route and the Build scenario route, organized by year and severity level.

Table 7 on the following page presents the crash rates per MVMT for both the detour and original bridge route.

Table 7: Collision Rates per MVMT for Detour Route and Open Bridge Route

Detour Route Crash Rates		Original Bridge Route (AKA Build Scenario Route)	
K	0.00000	K	0.00000
A	0.01857	A	0.05482
B	0.04642	B	0.10963
C	0.12998	C	0.05482
O	0.45494	O	0.16445
PDO	0.01857	PDO	0.27408
Injury	0.38995	Injury	0.21927
Fatal	1.01202	Fatal	0.32890

Calculation of the collision rates was performed by first determining the five-year million vehicle miles traveled for the detour route and the “Build scenario” route. This was found by extrapolating each route’s estimated daily vehicle miles traveled over five years and dividing by 1,000,000. The resulting number was then used in the following equation to generate rates for each collision type.

These collision rates were multiplied by each detour route’s share of projected trips for each of the future years 2035 to 2064 to determine each year’s projected annual collisions, as organized by collision type (the total number of projected trips was used to calculate projected collisions for the “Build scenario”). Note that the Build scenario route is the same as the original bridge route, as although the bridge is to be reconstructed at a slightly changed alignment over Crooked Creek, the greater Build scenario route of Clifton Pond Road will not change.

Estimation of Future Collisions

After collision rates along each route are calculated, these rates are used to estimate future collisions under the No-Build versus Build scenario. The detour route volumes, whose calculation method is described in “Vehicle Detouring” above, are then multiplied by these collision rates. The presumption is that the historic collision rates will be maintained, absent clear evidence to the contrary, such as design improvements, and thus any additional trips sent to these routes will experience collisions at the same frequency as any other vehicle along this route. Using the aforementioned monetary values recommended for each collision by USDOT, the total collision cost incurred by the project in future years was determined for the No-Build

scenario (sum of collision values for the three detour routes) and the Build scenario (sum of collision values for the route containing the open bridge, modified by design improvements associated with the Project).

Cost of Future Collisions

The total projected collision-related cost of the detour route combined over the 30-year analysis period is \$81,309,305, whereas the total projected collision-related cost of the improved open bridge route over the same period is \$9,345,184. This represents savings of \$71,964,121.

Vehicle Travel Time Benefits

Vehicle-based Travel Time Benefits are based primarily on projected detours. The detour route assumed for this project has an estimated northbound and southbound travel time. The projected traffic on each detour is multiplied by the estimated travel time to determine how many additional vehicle hours would take place in a No-Build scenario compared to a Build scenario. The total excess vehicle-hours are multiplied by \$21.80 per hour, the all-purpose travel time value recommended by USDOT. Note that a travel time factor of 1.18 was applied to truck volumes.

In the No-Build scenario, expected travel time costs in the project opening year are \$1,249,514; with the reconstructed bridge, travel time costs are reduced to around \$714,008, a decrease of about \$535,506, or about 57%. Savings are only expected to continue as the bridge reaches its 30-year operations mark, where savings of \$2,045,347 are expected.

Vehicle Operating Cost Savings

Like Vehicle Travel Time Benefits, the Vehicle Operating Cost Savings are based on the projected detours that result from the bridge closure. The projected traffic on the detour route is multiplied by the detour route distance to determine how many additional vehicle miles would take place in a No-Build scenario compared to a Build scenario. The total excess vehicle miles are multiplied by a rate of \$0.56 per mile for light-duty vehicles (such as personal vehicles) and \$1.27 per mile for commercial trucks.

Similarly, longer detours equate to higher degradation of equipment due to longer usage and travel times. In a No-Build scenario, vehicle operating costs are estimated to be \$1,562,627 in the project opening year. With the direct route between NC-98 and Triangle North Executive Airport provided by the bridge, operating costs are brought down to about \$825,807, which is about a \$766,820 decrease (a 52% decrease in costs). By 2062, savings are expected to reach about \$2,929,240. While not calculated in this BCA, the detour caused by the No-Build scenario will also accelerate the wear-and-tear costs on the roadway infrastructure along said detour route.

Emissions Benefits

Emission-related costs are based on recommended USDOT per-mile values that correspond to specific vehicle types. A general recommended value of \$0.016 per mile (attributable to all vehicles) was utilized to estimate the future emission costs for the No-Build scenario (assuming vehicles travel along the detour route) and the Build scenario (vehicles travel via the bridge). A total emission-related cost of \$1,396,101 was calculated for the Build scenario, while \$2,692,480 was calculated for the No-Build scenario. This represents savings of \$1,296,380.

Other Highway Externalities

As noted previously, the No-Build scenario generates a detour route that ultimately increases travel time costs, vehicle operation costs, and emissions costs. Other highway externalities that result from increased volumes on these detour routes were also considered, specifically through noise, congestion, and safety costs. The increased distances of each detour were multiplied with the expected user volumes and with the costs per VMT provided by USDOT.

By the bridge opening in 2034, an average of about \$230,307 would be saved by eliminating bridge detours. This number will more than triple by 2062, saving about \$879,649.