US 701 BUSINESS (MADISON STREET) AT SOULES SWAMP PROJECT

NCDOT, Priority 7

BENEFIT COST ANALYSIS NARRATIVE



OCTOBER 2026

US 701 Business (Madison Street) at Soules Swamp Project

BCA Narrative

FY 2024-2026 Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation Competitive Grant Program

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Executive Summary

The North Carolina Department of Transportation (NCDOT) proposes the US 701 Business (Madison Street) at Soules Swamp Project to improve flood resilience along US 701 Business (Madison Street) at Soules Swamp in Whiteville, Columbus County, North Carolina. The Project would increase the corridor's capacity to convey floodwater through larger bridge openings and improve adjoining roadway elevations, drainage, and pedestrian infrastructure. These improvements are intended to reduce flooding of Madison, Lee, and Franklin Streets and nearby downtown properties, shorten roadway closures, and preserve access to businesses, schools, medical care, and community services.

Madison Street is a primary north-south connection through downtown Whiteville, carrying approximately 12,500 vehicles per day, including 4.8 percent trucks, based on NCDOT's 2025 traffic count. The corridor serves local freight, school buses, on-demand transit, and residents traveling between neighborhoods and destinations on either side of Soules Swamp. It also provides an alternative route when incidents or seasonal congestion affect US 701 Bypass. Recurring flooding has inundated the bridge approaches and the Madison-Lee-Franklin intersection, disrupted travel, and damaged downtown businesses. The grant narrative documents at least eight flood events between 2016 and 2025 associated with hurricanes, tropical storms, and heavy rainfall. Maintaining access across the swamp is particularly important for police and fire services reaching southern Whiteville and for residents traveling to Columbus Regional Healthcare.

The Project includes replacement of the existing Madison Street bridge with an approximately 180-foot structure comprising three 60-foot spans, together with construction of a second, approximately 100-foot bridge comprising two 50-foot spans about 0.1 mile south of the existing crossing. The larger openings would allow additional floodwater to pass through the roadway corridor and reduce upstream water levels. The Project would also raise the grade of Lee Street between Cypress Street and Madison Street and provide associated paving, drainage, curb and gutter, sidewalk, riprap slope protection, guardrail, and utility adjustments. Pedestrian improvements include replacement of the existing wooden walkway with a five-foot concrete sidewalk across the floodplain and improved sidewalk connections along Lee Street.

Hydraulic modeling of the evaluated alternatives indicates potential water-surface elevation reductions of approximately 0.82-0.99 feet during the 50-year flood event and 0.49–0.64 feet during the 100-year event. NCDOT's preliminary roadway closure estimates indicate that the proposed improvements would eliminate modeled closures during the 25- and 50-year events and reduce closure duration during the 100-year event from 18 hours to 10 hours. These improvements would reduce temporary detours and flood-related infrastructure repair needs while supporting more reliable emergency response, local deliveries, and access to downtown destinations. Reduced flood exposure could also lessen damage to commercial properties and help businesses resume operations

sooner after storms. Some inundation and roadway closures would remain possible during severe events.

Construction is anticipated from February 2029 through August 2030, following preliminary engineering, design, environmental review, and right-of-way and utility activities. Construction would be phased to maintain through traffic along the corridor. The completed Project would strengthen a key connection to downtown Whiteville (the county seat) and improve the community's ability to maintain access and recover from recurring floods.

This Benefit-Cost Analysis (BCA) compares continued operation of the existing crossing and roadway network under the No Build scenario with the flood resilience improvements under the Build scenario. It estimates benefits and costs in constant 2024 dollars and applies a 7 percent real discount rate, consistent with USDOT's 2026 Benefit-Cost Analysis Guidance for Discretionary Grant Programs.

The Project is estimated to generate $1.06 million in discounted benefits compared to $8.30 million in discounted costs, yielding a net present value (NPV) of -$7.22 million and a benefit-cost ratio (BCR) of 0.13. Table 1 summarizes these results. The monetized analysis, however, does not capture several potentially substantial benefits associated with reduced downtown flooding, business continuity, and emergency access. These benefits are discussed qualitatively and are excluded from the reported BCR.

TABLE 1: BCA SUMMARY

Description	Value
Discounted Benefits	$1,057,234
Discounted Costs	$8,308,563
Net Present Value	($7,251,329)
Benefit-Cost Ratio	**0.13**

As shown in Table 2, the principal monetized benefits are avoided flood-related maintenance and repair costs of $579 thousand and residual value of $463 thousand, representing 44 percent and 55 percent of total benefits, respectively over the thirty-year period of captured benefits. Transportation user benefits arise from shorter or avoided temporary flood closures, which reduce detour travel time, vehicle operating costs, crash exposure, and emissions. Travel time savings total $8,500, vehicle operating cost savings total $3,800 thousand, and avoided safety costs total $2,500. These benefits are limited to the expected duration of flood-related disruptions. Additional quantified benefits include avoided emissions costs and highway external use costs.

The Project also has the potential to reduce flood damage to commercial properties, interruptions to downtown businesses and community services, and barriers to emergency response and medical

care. The available data and application schedule do not support defensible monetization of these effects. They are discussed qualitatively and excluded from the reported totals.

TABLE 2: BENEFITS SUMMARY

Description	Discounted Benefits	Share of Total
Residual Value	$462,674	44%
State of Good Repair	$578,807	55%
Vehicle Operating Benefit	$3,763	0%
Travel Time Benefit	$8,473	1%
Safety Benefit	$2,505	0%
External Use Cost Benefit	$127	0%
Emissions Benefit	$885	0%
Total	**$1,057,234**	**100%**

Purpose

Methodological Framework

The BCA uses a customized Excel model to estimate the incremental benefits and costs of the Project. The model links Project costs, traffic volumes, flood probabilities, roadway closure estimates, and detour characteristics to the resulting changes in travel and repair costs. Separate calculations estimate travel time, vehicle operating costs, safety, highway external use costs, emissions, avoided flood-related repairs, and residual value. The annual results are discounted and combined to calculate the BCR and NPV.[1]

The analysis expresses benefits and costs in constant 2024 dollars and discounts annual values to 2024 at a 7 percent real rate. Project costs provided in year-of-expenditure (YOE) dollars are converted to 2024 dollars using an assumed 3 percent annual inflation rate. This inflation adjustment is separate from discounting, which accounts for when real costs and benefits occur. Benefit monetization parameters follow USDOT's 2026 BCA Guidance.

The analysis follows the same overall approach for both scenarios, so that each benefit represents a change attributable to the Project. The principal analytical conventions are:

- Compare existing and future No Build and Build conditions over Project development and construction through 2030 and a 30-year operating period from 2031 through 2060. Estimate residual value for assets with useful service life remaining at the end of that period.
- Estimate transportation benefits from the change in expected flood-related closure hours, affected vehicle trips, detour miles, and detour travel time. Apply appropriate vehicle occupancy, travel time values, vehicle operating costs, crash rates and costs, and emissions parameters in constant 2024 dollars.
- Estimate avoided flood-related repair expenditures as an expected annual cost difference between the scenarios.
- Discount all annual benefits and costs at 7 percent to 2024.
- Discuss other Project outcomes qualitatively where available evidence does not support monetization.

BCA Process

The BCA first defines the Project scope and No Build baseline, then identifies the changes in flood exposure, roadway availability, and repair requirements attributable to the improvements. Traffic and detour inputs translate the closure-duration changes into vehicle miles traveled (VMT) and vehicle

[1] 2026 US Department of Transportation Benefit-Cost Analysis Guidance for Discretionary Grant Applications, Appendix A.

hours traveled (VHT). Monetization values convert these impacts into annual benefits, which are combined with avoided repair costs and residual value and compared with the full Project cost. Figure 1 summarizes the BCA process.

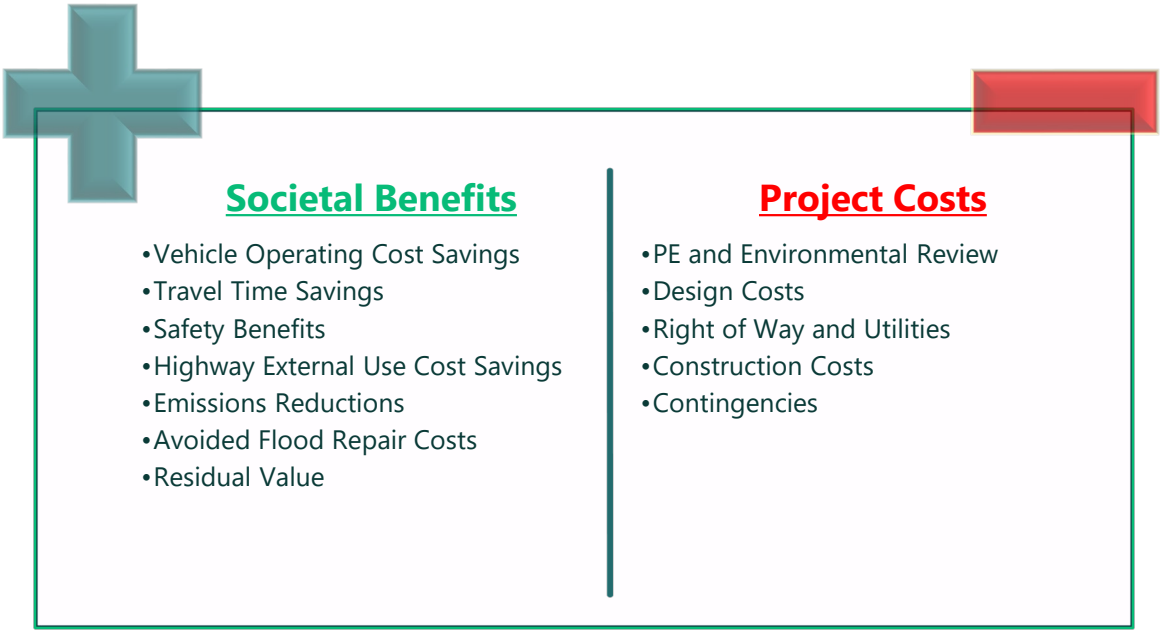


FIGURE 1: BCA PROCESS

Flood-related benefits are represented as expected annual values rather than as a schedule of storms assumed to occur with certainty. The analysis includes residual value in the final operating year to recognize the remaining usefulness of long-lived assets. Other potential benefits, including property protection, business continuity, and improved emergency access, are discussed qualitatively and are not added to the monetized totals. The reported BCR therefore reflects the benefits supported by the quantitative analysis rather than every potential outcome of the Project.

Project Overview

Existing Conditions and Challenges

US 701 Business (Madison Street) crosses Soules Swamp near the southern entrance to downtown Whiteville in Columbus County. The corridor carries approximately 12,500 vehicles per day, including 4.8 percent trucks, based on the 2025 traffic count reported by NCDOT. It provides a direct north–south connection between businesses and neighborhoods on either side of the swamp and serves school traffic, local freight, and on-demand transit. Madison Street also provides an alternative when incidents or seasonal congestion affect US 701 Bypass.

The existing bridge, Structure No. 230003, was built in 1961. The need for this Project centers on the hydraulic capacity of the crossing and flood vulnerability of the adjoining roadway network. Floodwaters can inundate the approaches and the Madison–Lee–Franklin intersection even when the bridge itself remains structurally serviceable. The BCA therefore evaluates temporary loss of access during floods and associated damage, rather than assuming that age or structural deterioration will force permanent closure.

At least eight flood events have occurred between 2016 and 2025 associated with hurricanes, tropical storms, and heavy rainfall. These include Hurricane Matthew in 2016, Hurricane Florence in 2018, Tropical Storm Idalia and other rainfall in 2023, storms in 2024, and thunderstorms and a coastal storm in 2025. The affected locations include Madison, Lee, and Franklin Streets and the downtown business district. Flooding has damaged businesses and interrupted access to the community's commercial and public-service destinations.

The consequences extend beyond the bridge crossing. Police and fire services north of Soules Swamp use Madison Street to reach southern Whiteville and nearby areas. Columbus Regional Healthcare, the hospital identified in the grant narrative, lies northeast of the Project area. Closures can redirect trips to the bypass, reduce route flexibility during a storm, and complicate access for residents, emergency responders, employees, customers, and deliveries.

NCDOT's completed flood closure worksheet identifies the approaches and adjoining intersection as the locations controlling through-traffic access for the modeled events. Existing closure durations are estimated at 10 hours for the 25-year event, 12 hours for the 50-year event, and 18 hours for the 100-year event. Corresponding inundation durations are 16, 24, and 32 hours. These estimates distinguish the presence of floodwater from the period during which the roadway cannot carry traffic.

Recurring flooding also creates repair and recovery demands. NCDOT has provided an estimated future repair cost of $350,000 per damaging event for use in the BCA. Repeated storm damage consumes maintenance resources and can delay restoration of normal operations. The Project

addresses these recurring disruptions by increasing the waterway opening and improving the adjoining roadway, rather than relying only on repairs after each damaging event.

No Build

Under the No Build scenario, the existing bridge and roadway configuration remain in service, with routine maintenance and repairs necessary to continue operation. No additional bridge opening or Project-related increase in hydraulic capacity is assumed. The corridor remains vulnerable to floodwater backing up at the crossing and inundating the approaches, the Madison-Lee-Franklin intersection, and nearby downtown properties.

Through traffic is diverted when the bridge approaches or adjoining roadway become impassable. The BCA uses the event-specific closure estimates provided by NCDOT to represent those disruptions. Traffic otherwise continues to use the existing corridor. No permanent bridge closure in 2030, structural load-posting progression, or continuous post-closure detour is assumed.

The BCA assumes that traffic uses the detour via Quality Street, US 701 Bypass, and Virgil Street during the 25- and 50-year flood events. For the 100-year event, the analysis assumes the longest identified detour route, following US 701 South, SR 1004, NC 410, and US 74. This assumption reflects the potential for severe flooding to compromise the shorter bypass connections and require a regional diversion. Although these alternate routes maintain connectivity, they increase travel distances and travel times during flood-related closures.

The No Build scenario retains the expected costs of flood-related repairs and the transportation impacts of temporary closures. Downtown businesses and the community would also remain exposed to property damage, interrupted operations, and reduced access during floods. Those broader effects are discussed qualitatively because the available information is insufficient to estimate their incremental monetary value with the precision needed for the BCA.

Build

The Build scenario replaces the existing Madison Street bridge with a structure providing a larger waterway opening and adds a second bridge opening to the south. The Build scenario includes an approximately 180-foot replacement bridge with three 60-foot spans and a new approximately 100-foot bridge with two 50-foot spans about 0.1 mile south of the existing crossing. The improvements are intended to convey more floodwater through the corridor and reduce upstream water levels and roadway inundation.

The Project also raises the grade of Lee Street between Cypress Street and Madison Street using roadway wedging, curb and gutter, and sidewalk construction. Associated work includes paving, drainage, riprap slope protection, guardrail, utility adjustments, and right-of-way needs. The proposed pedestrian improvements replace the existing wooden walkway with a concrete sidewalk

across the floodplain and improve connections along Lee Street. No additional through-traffic lanes are proposed.

The hydraulic analysis conducted for the Project indicates water-surface reductions of approximately 0.82–0.99 feet for the 50-year event and 0.49–0.64 feet for the 100-year event across the alternatives evaluated. The proposed alternative would eliminate modeled closure time for the 25- and 50-year events and reduce closure time for the 100-year event from 18 to 10 hours. Residual flooding and closure remain possible during larger events, so the Build scenario does not assume complete protection from all storms.

Construction is anticipated from February 2029 through August 2030, following preliminary engineering, design, environmental review, and right-of-way and utility activities. Construction will be phased or staged so that the existing bridge remains open to traffic. The BCA captures the first full year of operating benefits in 2031 and continues through 2060.

The combined improvements are expected to reduce temporary detours and storm-related repair needs while maintaining the corridor's role in everyday travel and community access. The Project also is also expected to lessen flooding of nearby commercial and residential properties and support more reliable downtown business activity and recovery. These outcomes are described in the qualitative benefits section where the available information does not support monetization.

Project Costs

Project costs include preliminary engineering and NEPA activities (PE & NEPA), right-of-way (ROW), gauge addition, and construction. The Project includes replacement of the existing bridge, construction of the second bridge, and associated roadway, drainage, sidewalk, protective, and utility work. The Lee Street improvements include grade adjustments, drainage, paving, curb and gutter, and sidewalk work. The estimate also includes engineering, construction inspection, and contingency allowances. Tables 3 and 4 summarize costs by category in YOE and constant 2024 dollars, respectively. The total Project cost is $13.550 million in YOE dollars and $11.668 million in constant 2024 dollars.

For the BCA, the supplied cost estimate is assumed to be in YOE dollars. Expenditures are allocated to the years in which the work is scheduled and converted to 2024 dollars using 3 percent annual inflation. For example, a cost incurred in 2029 is divided by five years of compounded inflation at 3 percent to express it in 2024 purchasing power. The resulting constant-dollar expenditures are then discounted separately at 7 percent. This approach includes the full resources required to deliver the Project, regardless of the Federal or non-Federal funding source.

TABLE 3: PROJECT COST BY COMPONENT IN YOE DOLLARS

Description	Project Cost
PE & NEPA	**$1,785,000**
ROW	**$400,000**
Gauge Addition	**$50,000**
Construction	**$11,315,000**
Total	**$13,550,000**

TABLE 4: PROJECT COST BY COMPONENT IN 2024 DOLLARS

Description	Project Cost
PE & NEPA	**$1,615,686**
ROW	**$355,395**
Gauge Addition	**$41,874**
Construction	**$9,655,346**
Total	**$11,668,301**

Table 5 summarizes the annual distribution of Project costs in constant 2024 dollars before discounting. The schedule allocates preliminary engineering to March–June 2027, design to June 2027–June 2028, environmental activities to March–June 2028, right-of-way and utility activities to June–December 2028, and construction to February 2029–August 2030.

TABLE 5: PROJECT COSTS BY YEAR (2024 DOLLARS)

Description	2027	2028	2029	2030
PE & NEPA	$1,020,955	$594,731	$0	$0
ROW	$0	$355,395	$0	$0
Gauge Addition	$0	$0	$0	$41,874
Construction	$0	$356,461	$5,450,407	$3,848,478
Total	**$1,020,955**	**$1,306,587**	**$5,450,407**	**$3,890,352**

BCA Input Data

Project inputs are based on NCDOT traffic data, flood-related roadway closure estimates supplied by NCDOT's bridge engineering team, hydraulic modeling findings, the preliminary cost estimate, and NCDOT's estimate of future flood-related repair costs. Values recommended by USDOT in the 2026 BCA Guidelines provide the monetization parameters for transportation impacts. The key inputs describe the frequency of disruptive floods, roadway closure durations under the No Build and Build

scenarios, the detour routes assumed for each event, and the resulting changes in costs to travelers and NCDOT.

Demand

NCDOT reports a 2025 AADT of 12,500 vehicles on US 701 Business (Madison Street), with trucks comprising 4.8 percent. This corresponds to approximately 11,900 passenger vehicles and 600 trucks per day, or about 4.56 million vehicle trips per year using 365 days. The BCA assumes stable traffic volumes across the operating period and the same underlying demand in the No Build and Build scenarios. The Project increases hydraulic capacity and roadway resilience without adding traffic lanes, so no induced traffic is assumed.

Flood Probabilities and Roadway Closure Durations

NCDOT's bridge engineering team provided information on existing and proposed inundation and roadway closure durations for the 25-, 50-, and 100-year flood events. Their annual exceedance probabilities are 4, 2, and 1 percent, respectively. A return period expresses the probability of an event being equaled or exceeded in any given year and does not imply occurrence at fixed intervals.

For the 25-year event, estimated inundation declines from 16 hours under No Build to zero under Build, and closure declines from 10 hours to zero. For the 50-year event, inundation declines from 24 hours to zero, and closure declines from 12 hours to zero. For the 100-year event, inundation declines from 32 to 24 hours, and closure declines from 18 to 10 hours. The 25-, 50-, and 100-year estimates are identified as 2D model simulation results. The 10-year estimate is based on extrapolation of peak flow against the existing bridge rating curve.

Roadway closure hours, rather than inundation hours, determine the period of diverted traffic. The controlling locations include the north bridge approach and Madison-Lee-Franklin intersection for the 25-year event, and both the north and south approaches for the 50- and 100-year events. The reported five-year general closure recurrence and historical downtown flooding provide context for the resilience need, but do not replace the event-specific estimates in the transportation calculation.

Annual transportation impacts reflect how often floods are expected to occur and how much the Project reduces roadway closures. The analysis applies annual probabilities of 4, 2, and 1 percent to the 25-, 50-, and 100-year flood events, respectively. Each probability is multiplied by the corresponding reduction in closure duration, and the resulting impacts are added to estimate annual transportation effects. Smaller floods are excluded from quantified transportation impacts. The 100-year closure and detour assumptions also represent larger floods, and flood probabilities remain constant throughout the analysis period. See Table 6.

TABLE 6: FLOOD PROBABILITIES AND EXPECTED CLOSURE HOURS AVOIDED

Flood event	Annual probability used	Closure hours avoided per event	Expected closure hours avoided per year
25-year	4%	10	0.40
50-year	2%	12	0.24
100-year	1%	8	0.08
Total	—	—	**0.72**

Detour Inputs

Detour inputs reflect the route available during each flood event rather than a permanent diversion from Madison Street. For the 25- and 50-year events, the analysis assumes a detour via Quality Street, US 701 Bypass, and Virgil Street. For the 100-year event, the analysis assumes the longer regional route via US 701 South, SR 1004, NC 410, and US 74 to account for the possibility that severe flooding makes the shorter bypass connections unavailable. The same closure and detour assumptions are applied to larger floods.

The analysis uses net additional detour distances of approximately 0.35 miles per trip for the 25- and 50-year events and 22.79 miles per trip for the 100-year event. These inputs represent additional mileage compared with the normal route. Additional travel time is estimated using an assumed average speed of 25 miles per hour, resulting in approximately 0.84 minutes and 54.7 minutes per trip, respectively. The reduction in closure hours, combined with traffic volumes and flood probabilities, determines the expected number of trips that avoid this additional mileage and travel time.

Flood Repair and Asset Life Inputs

The repair calculation uses NCDOT's estimated $350,000 per damaging event and an assumed five-year recurrence to develop expected annual expenditures. The covered repair activities, estimate dollar year, and reduction expected under Build define the applicable cost difference. The residual value calculation uses constant-dollar Project costs, 30 years of captured operating benefits, and component-specific useful lives.

Construction Disbenefits

Construction will be phased or staged, with the existing bridge remaining open to traffic. No full bridge closure or sustained traffic diversion is anticipated during construction, and no construction-related detour disbenefits are included in the BCA.

Benefits

The Project generates benefits by reducing the disruption and repair costs associated with flooding along Madison Street and the adjoining roadway network. A larger waterway opening and the second bridge improve conveyance through the floodplain, while the Lee Street work improves the elevation and resilience of a vulnerable approach. The analysis measures the resulting difference in expected flood-related closure time and repair expenditures between the No Build and Build scenarios.

Benefits begin in 2031, the first full year following anticipated completion in August 2030, and continue for 30 years through 2060. Transportation benefits accrue only when the Project reduces a flood-related interruption that would otherwise occur. Avoided repairs are valued as expected annual cost savings, and residual value is included once in the final year. Property protection, business continuity, emergency access, and other effects that cannot be defensibly monetized are discussed separately.

Travel Time Savings

Flood-related closures divert travelers from Madison Street to alternate routes. Reducing those closures allows affected trips to use the normal route for more hours during a storm and avoids the additional time required for the detour. The BCA estimates avoided vehicle hours from the difference in expected closure duration, affected traffic volumes, and the travel time difference between the normal and detour routes.

Passenger vehicle time savings are converted to person hours using the applicable average occupancy factor and valued using USDOT's value of travel time for the assumed trip purposes. See Table 7. Truck time is valued using the commercial driver time parameter. The analysis does not add a separate allowance for unmeasured intersection delay or assume daily time savings outside flood closures. The consequences of delayed emergency response are discussed qualitatively because ordinary travel time values do not measure changes in emergency outcomes.

TABLE 7: TRAVEL TIME INPUTS & PARAMETER VALUES

Description	Unit	Value
Average Vehicle Occupancy Rates for Highway Passenger Vehicles (and Trucks)		
Passenger Vehicles (All Travel)	factor	1.52
Trucks	factor	1.00
Value of Travel Time Savings (Value per Person-Hour)		
All Purposes	2024 dollars	$21.80
Truck Drivers	2024 dollars	$37.20

Vehicle Operating Cost Savings

Temporary detours increase the mileage required to complete trips and the associated costs of fuel, maintenance, tires, and vehicle wear. The BCA estimates avoided VMT from the affected trips, the change in expected closure hours, and the additional net distance of the applicable detour. Passenger vehicles and trucks are considered separately because their per-mile operating costs differ.

Avoided miles are multiplied by USDOT's recommended vehicle operating cost values to estimate annual savings in constant 2024 dollars. These savings occur only during the expected periods when the Build scenario maintains access that would be unavailable under No Build.

Avoided Safety Costs

Reducing detour travel can reduce crash exposure by avoiding additional roadway mileage. The quantitative safety calculation applies the appropriate North Carolina crash rates to avoided VMT and values the expected change in fatal, injury, and property-damage-only crashes using USDOT's recommended crash costs. A rate expressed per 100 million VMT is applied after converting avoided travel to the same units. Table 8 shows the inputs used in the safety analysis.

TABLE 8: SAFETY COST INPUTS & PARAMETER VALUES

Description	Unit	Value
Value of Reduced Fatalities, Injuries, and Property Damage Only		
Fatal Crash	2024 dollars	$15,366,900
Injury Crash	2024 dollars	$342,400
PDO Crash	2024 dollars	$9,700
Fatalities, Injured Persons, and Crash Rates per 100 Million Vehicle Miles Traveled		
Crashes per 100 Million Vehicle Miles Traveled	crashes	223.99
Fatal Crashes per 100 Million Vehicle Miles Traveled	crashes	1.28
Injury Crashes per 100 Million Vehicle Miles Traveled	crashes	57.69
PDO Crashes per 100 Million Vehicle Miles Traveled	crashes	165.02

This method represents the effect of reduced exposure during temporary flood closures. It does not assume a Project-specific crash reduction from the bridge replacement, Lee Street work, or sidewalk improvements without supporting evidence.

Other potential safety outcomes include improved pedestrian access, fewer encounters with flooded roadways, and better access for emergency services. These effects are discussed qualitatively because local exposure data, treatment-specific effectiveness estimates, and evidence linking the Project to avoided incidents are insufficient for a separate monetary estimate.

Avoided Highway External Use Costs

Avoided detour VMT can reduce congestion and noise costs imposed on other roadway users and nearby properties. The calculation applies the appropriate USDOT per-mile external cost values to the avoided passenger vehicle and truck mileage, using the location and vehicle categories that correspond to the detour routes. See Table 9.

TABLE 9: HIGHWAY EXTERNAL USE COST INPUT & PARAMETER VALUES

Description	Unit	Value
Congestion External Highway Use Costs (Recommended Value of Cost per Vehicle Mile Traveled)		
All Vehicles – All Locations	2024 dollars	$0.136
Noise External Highway Use Costs (Recommended Value of Cost per Vehicle Mile Traveled)		
All Vehicles – All Locations	2024 dollars	$0.003

These values represent effects on others and are separate from the detouring traveler's own time and operating costs. No additional pavement wear or separate crash allowance is added under this category. The estimated savings are limited to changes in expected flood-related detour mileage, with no assumption of a general reduction in recurring corridor congestion.

Avoided Emissions Costs

Avoiding additional detour travel also reduces emissions of nitrogen oxides (NOx), sulfur oxides (SOx), and fine particulate matter (PM2.5). The analysis combines avoided VMT with the applicable emissions factors (see Table 10) and converts the resulting pollutant quantities to the units used by USDOT's damage-cost values.

TABLE 10: EMISSIONS INPUT & PARAMETER VALUES

Description	Unit	Value
General Parameters		
Grams to Metric Ton	factor	0.000001
Passenger Vehicle Emissions Factors		
NOx	grams per mile	0.199
SOx	grams per mile	0.004
PM2.5	grams per mile	0.007
Truck Emissions Factors		
NOx	grams per mile	3.114
SOx	grams per mile	0.015
PM2.5	grams per mile	0.073

Pollutant reductions are valued by year and discounted with the other benefits. The analysis does not add unmeasured idling reductions or a separate monetary value for carbon dioxide emissions. The

Project's primary environmental contribution is its flood resilience function, while the modeled air-pollution benefits reflect the smaller change in expected detour travel.

Avoided Flood-Related Maintenance and Repair Costs

The maintenance benefit represents flood-related repair costs avoided under the Build scenario. NCDOT estimates future repair costs of $350,000 per damaging event. The BCA combines this amount with an assumed 20 percent annual probability of a damaging event, equivalent to a five-year average recurrence, to estimate $70,000 in expected annual repair expenditures under No Build. These expenditures are assumed to be avoided under Build, resulting in $70,000 in annual avoided costs before conversion to the BCA's dollar year.

Residual Value

Residual value recognizes the remaining usefulness of Project assets after the 30-year operating period. The analysis assumes a 75-year useful life for the structure component and a 20-year useful life for the Lee Street roadway component. Weighting these assumptions by their respective estimated costs of $8.5 million and $1.6 million produces an average useful life of approximately 66.3 years.

A straight-line method applies the share of useful life remaining after 30 years to construction costs of $9,655,346 in constant 2024 dollars. This produces an estimated residual value of $5,285,563 at the end of the analysis period in 2060. No residual value is assigned to preliminary engineering, environmental review, or right-of-way costs. The residual value is discounted to 2024 using the 7 percent real discount rate and included once in the benefit total.

Qualitative Benefits and Disbenefits

The Project's larger hydraulic opening and roadway improvements have the potential to produce benefits beyond the transportation and repair effects captured in the BCA. These include reduced damage to downtown properties, fewer business interruptions, and more reliable access during storms. The available data and application schedule do not support the property-level, operational, and emergency-service analyses required to monetize these outcomes defensibly. They are therefore discussed qualitatively and excluded from the reported BCR. The discussion identifies how the Project could produce each benefit without assuming that all flooding or storm damage would be eliminated.

Reduced Property Damage and Flood Cleanup

Lower flood elevations and shorter inundation periods can reduce damage to buildings, equipment, inventory, and other assets in downtown Whiteville. Floodwater entering commercial buildings can damage flooring, wall finishes, electrical and mechanical systems, furnishings, and stored goods. Prolonged inundation can increase the extent of damage and the work needed to clean, dry, repair, or replace affected materials. Even when a building remains structurally sound, these impacts can impose substantial restoration costs on property owners and tenants.

Past storm events have severely affected businesses along Madison Street, including J.S. Mann's, Family Dollar, Southern Tire, Murf's Pawn, and Colliers Jewelers. The inundation area includes 26 active businesses, and reduced flooding could also benefit additional commercial properties. Improving flood conveyance through the Soules Swamp crossing could reduce the depth or duration of flooding at affected properties, limiting damage to buildings and their contents. These benefits could occur even where the Project does not eliminate flooding entirely. Shallower flooding may expose fewer assets to water, while shorter inundation can limit prolonged water exposure and allow cleanup and repairs to begin sooner.

The 2023 Whiteville Community Floodprint provides additional evidence of existing property exposure. Within the broader Downtown and Soule's Swamp study area, the assessment identified 111 structures within the 500-year floodplain. Of these, 25 were projected to sustain approximately $1.64 million in structural damage during a modeled 500-year flood event. These findings illustrate the potential magnitude of damage during severe flooding. However, the assessment covers a broader area than the Project's immediate surroundings and does not establish which properties would experience reduced flooding or the amount of damage the Project would avoid.

Reduced flood exposure could also lessen the need for debris removal, disposal of damaged inventory and furnishings, sediment removal, building cleanup, and drying. Property owners and businesses may require fewer repairs or less extensive restoration following storms, reducing the resources needed to return affected properties to usable condition. The extent of these benefits

would vary with each property's elevation, building characteristics, contents, and exposure to individual flood events. Properties experiencing the greatest reduction in flood depth or duration could receive larger benefits, while others may continue to face substantial damage.

The hydraulic findings support the potential for less severe or shorter flooding but do not establish avoided losses at individual buildings. Defensible monetization would require property-specific floor elevations, flood depths and durations under No Build and Build, building and contents values, and appropriate relationships between flood exposure and damage. Estimates of cleanup and restoration costs would also be needed where those costs are not already represented in the damage calculations. These inputs would need to be evaluated across flood-event probabilities to estimate the reduction in expected annual losses attributable to the Project. These inputs are unavailable at the necessary level of detail. Reduced property damage and cleanup are therefore discussed qualitatively and excluded from the reported BCR.

Emergency Response and Access to Medical Care

Maintaining access across Soules Swamp can improve the reliability of police, fire, and emergency services during storms. Police and fire services are located north of the swamp, and Madison Street provides their most direct route to southern Whiteville and nearby communities. Although EMS and Highway Patrol generally use US 701 Bypass, maintaining access on Madison Street provides an additional route when the bypass is congested, affected by an incident, or disrupted by flooding.

More reliable access can also help residents reach Columbus Regional Healthcare and other medical services. These benefits extend beyond travel time savings because delays in treatment or emergency response can affect health outcomes, life safety, and property losses. Emergency access benefits are therefore discussed qualitatively without assigning an assumed number of lives saved or avoided medical incidents.

Pedestrian Access and Safety

The existing wooden pedestrian walkway across the floodplain is in poor condition. The Project would replace it with a concrete sidewalk, improving the condition and continuity of the pedestrian connection along Madison Street. Sidewalk and curb-ramp improvements along Lee Street would also improve access to the crossing and nearby destinations. Together, these improvements can make everyday walking more comfortable and accessible for people who depend on pedestrian travel, including those with mobility limitations.

Maintaining a usable pedestrian connection is especially relevant when flooding disrupts the surrounding network and limits route choices. Replacing the deteriorated walkway would address an existing infrastructure deficiency while supporting pedestrian access through the corridor. Pedestrian volumes, existing pedestrian crash exposure, and the expected reduction in crashes associated with

the improvements are not available. Improved pedestrian access and safety are therefore discussed qualitatively, with no separate monetary benefit or quantified crash reduction assigned.

Business Continuity and Local Deliveries

Flooding affects downtown businesses through direct damage and through interruptions to customer access, employee travel, deliveries, and day-to-day operations. Reducing the depth or duration of flooding can shorten closures, help protect inventory and equipment, and allow businesses to resume activity sooner after storms. The corridor's local truck traffic and the presence of businesses on both sides of Soules Swamp make more reliable access relevant to deliveries and local services as well as customer trips.

The available information does not establish business-specific outage durations, lost production, recovery costs, or the share of activity that is postponed or transferred to other locations. Gross sales losses cannot be assumed to equal net societal losses. Business continuity and delivery reliability are therefore discussed qualitatively, with no employment, revenue, or economic impact multiplier added to the BCA. This treatment avoids counting the same effect through property damage, travel savings, and business activity.

Community Services and School Access

Madison Street connects residents to schools, local services, government offices, and downtown destinations. School buses serving four local schools use the corridor, and Whiteville High School on Lee Street generates substantial school-related traffic. Flood closures can require changes to bus routes, disrupt schedules, and make routine trips more difficult for households and service providers.

Reducing closures can support more reliable access for students, caregivers, on-demand transit passengers, and people traveling to public services. These effects depend on when storms occur, whether destinations remain open, and whether connecting roads remain usable. School schedules, passenger counts, and service-disruption records are unavailable to distinguish these impacts from the vehicle travel savings already included in the BCA. Continuity of community services is therefore discussed qualitatively.

Recovery and Transportation Network Reliability

An additional usable route across Soules Swamp can improve the community's ability to maintain access and recover after storms. Madison Street provides redundancy when US 701 Bypass is affected by an incident or heavy seasonal traffic. Reducing the crossing's own flood vulnerability can preserve that alternative for cleanup crews, repair personnel, local deliveries, and residents returning to normal activities.

The Project can also reduce demands for temporary traffic control, road closure management, and post-flood inspection and cleanup where those costs are not already included in NCDOT's repair

estimate. These potential benefits depend on the severity of each event and conditions elsewhere in the network. No separate dollar amount is added for agency recovery activities or network redundancy because the necessary records and event-specific estimates are unavailable.

Property Values and Downtown Investment

Recurring flood damage and unreliable access can weaken the attractiveness of commercial properties, discourage reinvestment, and contribute to vacant or underused space. Reducing flood exposure could help preserve the usefulness of existing buildings and make affected sites more attractive for continued occupancy, renovation, or redevelopment.

Avoided erosion of property values is discussed qualitatively because there is no local analysis separating the Project's effect from market conditions or other investments. Changes in property values can reflect the same avoided damage and access benefits discussed elsewhere, so they cannot simply be added as another benefit. No property appreciation or property-tax revenue increase is included in the BCA.

Construction and Other Potential Disbenefits

The staged construction plan maintains through access, so the BCA includes no quantified construction detour disbenefit. Temporary work-zone activity, utility coordination, noise, dust, and changes to nearby property access may still affect residents and businesses during construction. Those effects are expected to be managed through the construction and traffic-control plans, but their duration and magnitude are not sufficiently defined for monetization.

The added bridge requires inspection and maintenance. Any net increase in routine or periodic maintenance must be reflected separately from avoided flood repairs. Benefits depend on the selected hydraulic design, and some inundation and closure remain during the modeled 100-year event and potentially larger floods.

BCA Summary

The BCA estimates $1.06 million in discounted benefits and $8.30 million in discounted costs for the Madison Street Bridge Expansion Project, resulting in an NPV of -$7.25 million and a BCR of 0.13. The monetized benefits are less than the estimated costs. These results reflect avoided flood-related repair costs, the remaining value of Project assets, and changes in expected transportation user and external costs during temporary flood closures. However, they do not capture the full range of potential benefits from reduced flooding in downtown Whiteville, which are discussed qualitatively. This wide range of qualitative benefits strongly aligns with the policy intent for the PROTECT program.

The principal monetized benefits are avoided flood-related maintenance and repairs and residual value. Detour-related savings are comparatively limited because the modeled closures last hours rather than representing a permanent loss of the crossing. The Project's broader potential value includes property protection, business continuity, reliable emergency access, and reduced disruption to community services. These effects are discussed qualitatively and are not included in the numerical BCR or used to assert that the ratio would exceed 1.0 if monetized. The letters of support speak to these significant qualitative benefits.