North Carolina Flood Mitigation: PROTECTing US 74 at the Lumber River

PROTECT FY 2022 and 2023

Grant Application

August 2023

North Carolina Flood Mitigation: PROTECTing US 74 at the Lumber River

During the last two major hurricanes that impacted North Carolina, US 74 at the Lumber River flooded and partially washed away. These events caused roadway closures that significantly impacted the local communities, including Areas of Persistent Poverty and Historically Disadvantaged Communities who rely on this route for everyday needs. Grocery stores, hospitals, fire stations, and police stations became inaccessible to these communities when the roadway was washed out.

Additionally, the lack of resilience along this section of US 74 creates significant problems during major weather events because US 74 is the southernmost east-west evacuation route in North Carolina that helps residents of low-lying areas in the southeastern part of the state, including the Wilmington area, reach I-95 and points west.

I. BASIC PROJECT INFORMATION

A. Project Description

US Route 74 has been identified by the North Carolina Department of Transportation (NCDOT) Strategic Transportation Corridors initiative as one of 25 critical multimodal transportation corridors considered the backbone of the state's transportation system that move most of the State's freight and people; link critical centers of economic activity to international air and sea ports; and support interstate commerce. While the entire US 74 system is being prioritized by the State, a specific location has been identified for this PROTECT Grant application called the **North Carolina Flood Mitigation: PROTECTing US 74 at the Lumber River**. This location at the Lumber River crossing needs improvements to augment and enhance the roadway due to historic trends of overtopping during high water events along an approximate 1,500 linear foot section. These flooding events cause extensive shoulder and lane degradation that close the roadway as shown in Figure 1, severing a critical evacuation route from the Atlantic coastline and a key connection to community services.

Figure 1: Large pavement failure in eastbound US 74 following Hurricane Matthew, October 2016

US 74 at the Lumber River crossing serves as a vital connection for local communities, emergency services, and goods. This crossing is also an important evacuation route from the coastline during

severe weather events, see Figure 2 for the regional context. As climate change, sea level rise, flooding, and extreme weather events continue to present challenges at this location, the NCDOT strives to maintain a resilient state, where communities, economies, and ecosystems are better able to rebound, positively adapt to, and thrive amid changing climate conditions and challenges.

In September 2021, NCDOT adopted an official resilience policy. The recent formalization of resiliency efforts has emerged from a combination of federal and state guidelines, including Federal Highway Administration (FHWA) Order 5520 and Governor Roy Cooper's North Carolina Executive Order (E.O.) 80. As directed by E.O. 80, the North Carolina Climate Risk Assessment and Resilience Plan was created to address North Carolina's vulnerability to climate change. In order to fulfill requirements of this legislation, NCDOT has adopted an official resilience policy and is actively identifying strategies to enhance the resiliency of the State's transportation network through planning products like the NCDOT Climate Strategy Report.

NCDOT defines resiliency as the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. To incorporate resiliency into future plans for the State's transportation system, NCDOT identified this Project, the **US 74 Flood Mitigation at the Lumber River**, to address the current flooding problem by reinforcing the shoulder and embankment with more durable materials. This will help ensure that the corridor is safe, remains efficient, and is a resilient link in the larger transportation network. This Project is eligible under the **Resilience Improvements and Community Resilience & Evacuation Routes** funding categories of the **PROTECT** discretionary program**.**

The NCDOT's mission is to connect people, products, and places safely and efficiently. The Department is committed to building a transportation system designed with sensitivity and resilience that can adapt to and recover from a wide array of disruptions. The Department's cooperative planning, policy development, construction, operation and maintenance efforts, and even academic research are incorporated into the future of the State's transportation system to ensure safety and resiliency for present and future generations. As later described in the Design Elements section of this narrative, shoulder hardening was identified as the preferred alternative improvement.

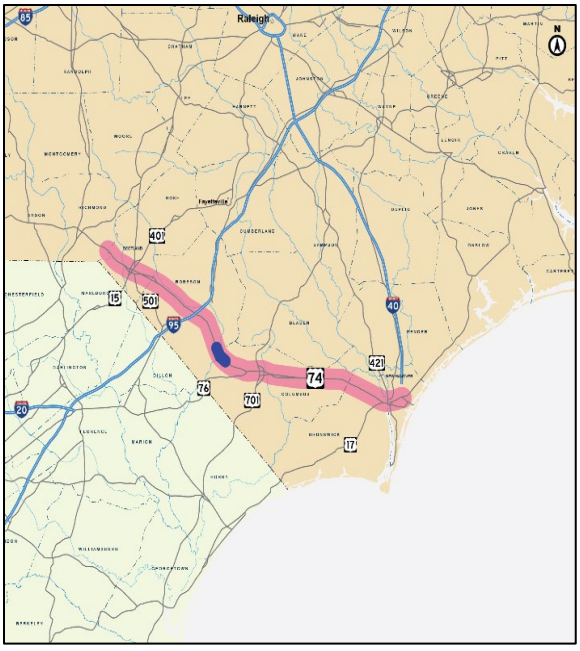

Figure 2: Regional Context for Project Location (34.442865, - 78.959761)

In preparation for these planned improvements, NCDOT has commissioned environmental, engineering, and planning studies. Of most relevance to this Project are the **US 74 Resiliency Study**[1] and the **US 74 Lumber River Crossing**

[1] Attachment (1)

Hydraulic Design Alternatives Report,[2] which were conducted to identify vulnerabilities, assets, and impacts throughout the system, along with key strategic actions needed by NCDOT to ensure the continuity of these assets (pipes, bridges, culverts) and that this critical transportation system can withstand extreme weather events and future climate conditions.

B. Project Location

The Project is located between the towns of Boardman in Columbus County and Orrum in Robeson County, North Carolina along US 74. This 1,500-foot long section of the highway, see Figure 3, crosses the Lumber River and its floodplain making it highly susceptible to overtopping and scouring. The Project reach is in the vicinity of US 74 and the Lumber River crossing predominately consists of swamp land and wooded wetlands throughout the floodplain with the inclusion of some agricultural and forestry lands and rural residential properties.

Figure 3: Project Location (1,500 feet long)

Many of the residential properties within the 100-year floodplain are in Robeson County along North Carolina Highway 72 (NC-72), just upstream of US 74, and along Ann Road (SR-2244) and VC Britt Road (SR-2245) on the downstream side of US 74. A wastewater treatment plant is located in the floodplain on Woodrow Road (SR-2312) on the downstream side of US 74 but sits above the 500-year water surface elevation (WSEL).

Figure 4: Corridor damage and repairs after Hurricane Matthew, October 2016

US 74 is the primary crossing of the Lumber River, a well-defined but narrow channel, often necessitating use of the surrounding floodplain to convey the discharge from large storm events. During these events, the flooding of local communities and the overtopping of crossings is common. The US 74 crossing between Columbus and Robeson Counties is no exception, with multiple flooding events in recent years causing considerable damage to hydraulic structures and the roadbed, necessitating costly repairs.

Flooding and the resulting damage can be a major obstacle to the flow of east-west traffic along the corridor, greatly increasing travel times for both local motorists and inter-regional

[2] Attachment (2)

truck freight. US 74 is also a vital link for emergency services during extreme weather events, including the evacuation route from the Wilmington area westward during hurricanes.

In October 2016, Hurricane Matthew hit North Carolina, causing extreme rainfall and flooding throughout the entire southeastern United States. Fast-moving water inundated US 74 and the Lumber River, which rose to an all-time record level, as shown in Figure 4. As a result, the US 74 crossing of the river was impassable for 10 days due to water overtopping the highway, causing major damage to the roadway, washing away extensive sections of shoulder in multiple locations, and leaving 2,525 feet of guardrail in need of being reset or replaced. The combination of saturated soils and strong water velocities also resulted in road surface lifting and the creation of large sink holes within the roadway lanes.

A similar event occurred in September 2018 during Hurricane Florence, which produced record-breaking rainfall and river flooding, see Figure 5. The storm caused extensive damage to the US 74 roadway and Lumber River crossing where water flow continuously overtopped the bridge for a 22-day period and eroded 4,000 feet of roadway shoulder and embankment. Additionally, guardrail needed to be replaced along a 4,000-foot length and the road surface and subgrade needed to be repaired.

Figure 5: US 74 overtopped from Hurricane Florence, September 2018

Consistent with NCDOT's commitment to building a transportation system that is adaptive and resilient, this Project seeks to strengthen and harden the US 74 Lumber River crossing to be more resilient to flooding and extreme weather events, allowing for faster recovery of the facility and for travel to resume sooner under these conditions without extended delay due to extensive damages and critically needed repairs.

C. Parties

Like all NCDOT projects, multiple parties will be involved in the construction. The Project's environmental planning and documentation will be accomplished under NCDOT's programmatic agreement with the Federal Highway Administration (FHWA) for processing actions classified as a Categorical Exclusion.

NCDOT also supports liaison positions that are dedicated to working on NCDOT projects, including the US Army Corps of Engineers, US Fish and Wildlife Services, NC Division of Water Resources, NC Wildlife Resource Commission, and the NC State Historic Preservation Office. Additionally, NCDOT has established multiple programmatic agreements with these federal and state agencies to further streamline project delivery.

II. GRANT FUNDS, SOURCES AND USES OF ALL PROJECT FUNDING

The Project will fund the planning, engineering, and construction of these resiliency improvements on this section of US 74 at the Lumber River. The Project cost is estimated at $2,254,500 and NCDOT is requesting $1,803,600 of PROTECT funding, 80% of the total project cost. Matching funds will be provided by State transportation funding sources. Refer to Table 1 for a funding breakdown by phase and source.

Table 1. Funding Sources

Item	Cost	Federal Share	NCDOT Match	% to HDC/AoPP
Planning (2024 $)	$42,000	$33,600	$8,400	100%
Engineering (2024 $)	$262,500	$210,000	$52,500	100%
Construction (2025 $)	$1,950,000	$1,560,000	$390,000	100%
Total	**$2,254,500**	**$1,803,600**	**$450,900**	100%

III. MERIT CRITERIA

A. Vulnerability and Risk

Because North Carolina's coastline extends out into the ocean, its coast is one of the Nation's most vulnerable areas to a direct hurricane strike. Many hurricanes have hit the State directly, and numerous hurricanes have passed near or through North Carolina for as long as records have been maintained. The State is ranked fourth in the United States, after Florida, Texas, and Louisiana, in the number of cyclones that have produced hurricane-force winds. Hurricanes in North Carolina's history are responsible for over $15.6 billion in damage (2023 USD) and almost 1,000 fatalities.

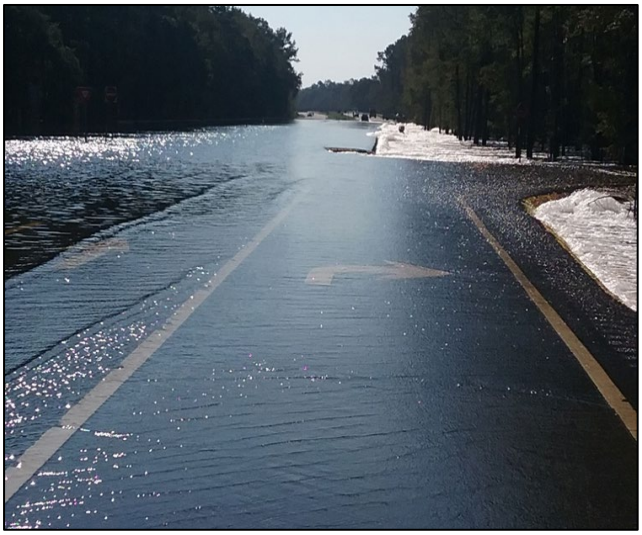

Figure 6: US 74 overtopping and shoulder scour Hurricane Florence, September 2018

Between 1851 to 2019, a total of 85 tropical cyclones have hit North Carolina. Of those 85 tropical storms, 52 of them were hurricanes, averaging one hurricane to make landfall every 3 to 4 years. Additionally, an estimated 17.5% of all North Atlantic tropical cyclones have affected the State. The following are some of the recent and worst hurricanes to impact North Carolina.

- August 2020: Hurricane Isaias was the most recent
- August 2018: Hurricane Florence was the most destructive and had the highest number of fatalities
- September 2003: Hurricane Isabel was the most intense storm with extensive storm surge

Thus, based on these historic trends, North Carolina is due for another hurricane in the near future.

According to the National Oceanic and Atmospheric Administration's (NOAA) 2022 Global Temperature Recap, the Earth's average land and ocean surface temperature in 2022 was 1.55 degrees Fahrenheit (F) above the 20th-century average. NOAA's Climate Explorer estimates that the total precipitation in Wilmington, North Carolina 60 miles east of the project location, is expected to experience an average 2-inch increase in the 2040s and an average 4-inch increase in the 2060s.

The average daily maximum temperature is expected to increase by 4-degrees F in the 2040s, and 5-degrees F with lower emissions or 6-degrees F with higher emissions in the 2060s. Additionally, according to the Climate Explorer, by the 2040s, it is also projected to have between 15 and 17 high-tide flooding days. By the 2060s, there could be between 59 and 97 high tide flooding days, depending on projected emissions levels. The combined effects of these projected conditions demonstrate the need for resilience mitigation action today.

As part of the **US 74 Resiliency Study**, a simulation was developed in conjunction with TransCAD, State and Metropolitan Planning Organizations (MPOs) regional travel demand modeling, and the 2019 American Community Survey 5-year estimate datasets, to assess Project impacts along the corridor from weather and climate-related disruptions over a 40-year period between 2020 and 2060. Rainfall, temperature, and sea level rise, all evidence-based climate change factors, were drivers embedded into the simulation to better understand the value of additional funding and spending towards resiliency for US 74.[3]

The models were used to compare the baseline "no-build" and resilience-focused improvements. When considering time, corridor growth, and climate change, the results estimated that future disruptions to the roadway would increase by 108% by 2060. This significant increase in disruptions would largely result from riverine flooding, as well as increased heat and sea level rise. Additionally, future demand on US 74 is projected to increase by 67% to 30,000 Annual Average Daily Traffic (AADT) from 20,000 AADT by 2042.

[3] Attachment (1) - (Pg. 4-1)

As the **US 74 Resiliency Study**[4] identified the many vulnerabilities of the US 74 corridor, NCDOT recognizes the risks to this transportation system that come along with natural hazards and climate change. Through shoulder hardening, this Project will address the PROTECT vulnerability elements of **Exposure, Sensitivity, and Adaptive Capacity**.

NCDOT prioritizes rebounding from storm events and positively adapting to changing climate conditions. Consequently, hardening the shoulder along US 74 will reduce the impacts, risks, and consequences of exposure by reducing the likelihood or potential for erosion of US 74 when the Lumber River overflows and overtops the bridge and the road approach embankment.

The improvements included with this Project will prevent dramatic pavement and embankment erosion in various locations near the river crossing during and after a flooding event. Reducing severe erosion of the roadway after an overtopping event will also reduce the likelihood of shoulder damage during shorter duration events and loss of roadway typical section during longer duration events. This improvement to US 74 is considered an important resiliency measure that will benefit the traveling public because it will ensure the integrity of the roadway during these severe storm flooding events. This approach will allow vehicular passage along the corridor to return to normal post-storm as soon as flooding subsides, rather than enduring extensive road closures when emergency roadway repairs are needed. In past events, the roadway has been closed for emergency repairs from 4 days to 15 days and longer.

B. Criticality to Community

As noted above, US 74 is a major east-west route that connects coastal Wilmington to Charlotte and other westward destinations. This Project is necessary to prevent flooding, roadway deterioration, and impassability of US 74, as well as support the operation and increase the rate of recovery after disasters for local, regional, and national surface transportation.

The importance and inherent criticality of reducing the duration of flood induced disruptions along this segment of US 74 is highlighted by the fact that this segment has an AADT of 23,500 vehicular trips and 3,330 truck trips, according to NCDOT AADT data. Given that the AADT is projected to increase by roughly 80,000 vehicles to 108,000 vehicles per day by

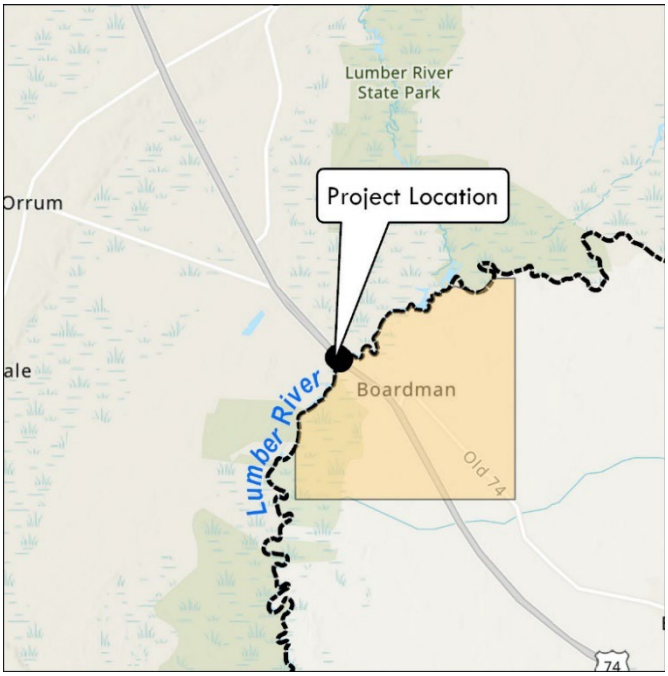

Figure 7: The nearby town of Boardman, just south of the Lumber River.

[4] Attachment (1) - (Pg. 5-1)

2060, impacts from extended road closure will also be multiplied significantly in the future.

US 74 is essential for local connectivity and access to emergency and community services, specifically for the town of Boardman, as shown in Figure 7. When US 74 is inoperable and closed due to reconstruction after a storm event (twice in the past seven years), traffic is directed to alternate local and regional routes. These diversions increase volumes and decrease capacity, thereby creating delays and increased travel times for local motorists and emergency services.

Figure 8: Roadway disruption after Hurricane Florence, September 2018

Facilities necessary to support the communities, including hospitals, grocery stores, fire stations, and police stations, are concentrated in Lumberton and are directly accessed by US 74. An assessment of the areas surrounding the Project demonstrate that within a 20-mile radius of this Lumber River crossing, there are 37 fire stations, 111 gas stations, 2 hospitals and 48 potential emergency shelters. Additionally, there are 8 financial institutions, 22 restaurants, and 48 schools within this same radius.

The closest hospitals to Boardman are approximately 20 miles away in Lumberton and Whiteville; additionally, most grocery stores, supermarkets, and police stations are only found in and around Lumberton. The next closest hospitals to Lumberton are located 36 miles away in Elizabethtown, 53 miles away in Fayetteville, and across the border in South Carolina. A volunteer fire station is located southeast of Boardman in Evergreen; however, the next closest fire stations are in Lumberton or further south in towns along US 76. The closest alternative crossing of the Lumber River is nearly 20 miles to the north at Willouby Road, so a less direct route becomes the only viable option during or after a storm event, which could mean the difference between life and death.

US 74 serves as a vital connection for the communities surrounding this Project location. As later noted in Section E. Equity and Justice, the Project contains communities that are considered transportation disadvantaged, as well as historically, health, economically, and resiliency disadvantaged. For the most vulnerable, it is critical that access to community services be maintained. As demonstrated in the **2023 US 74 Resiliency Study's**[5] underserved community access element, various facilities, and sustenance locations critical to basic human needs and emergency services are located within the region and river flooding events jeopardize access to these facilities.

[5] Attachment (1) – (pg. 4-43)

Evacuation:

Regionally, US 74 serves as a critical evacuation route from major storms for North Carolina residents living in Wilmington and its surrounding areas along the Atlantic coast. As demonstrated in the North Carolina Coastal Region Evacuation and Sheltering Standard Operating Guide, along with I-40 and US 421, US 74 serves as a primary evacuation route for the Southern Coastal Plain (SCP) risk counties, including Pender, New Hanover, and Brunswick Counties. These four counties collectively consist of nearly 630,000 residents.

Movement of Goods:

Nationally, US 74 is critical for highway freight movements, because it serves as a major east-west route across North Carolina. The corridor provides connectivity for substantial freight movements derived from the Port of Wilmington to I-95, northwest of the Project location, and ultimately the Midwest. The Wilmington Port is ranked 21st in the U.S. for container traffic, according to the Bureau of Transportation Statistics' port performance report, based on 2020 data. As of June 2023, about 2.8 million tons of general cargo moved through the Port of Wilmington in fiscal year 2022, a record high and a 27% year-over-year increase.

Because I-95 serves as a major north-south route along the East Coast for freight traffic with volumes generating billions of dollars in commodities, if US 74 is closed for any amount of time due to damage associated with a storm event, freight transportation will be disrupted, subsequently disrupting reliant economies, locally, regionally, and nationally. As severe storms, floodings, and sea level rise are expected to increase in the future, the likelihood of US 74 becoming impassable at the Lumber River crossing will also increase.

When US 74 is damaged and impassable, systemic impacts to the regional highway network create a greater burden on surrounding transportation facilities, especially during an evacuation event. Emergency response services, such as police, fire, and emergency medical services are delayed, subsequently impacting lives. The movement of goods via truck freight is also affected, thus generating immeasurable but profound latent economic loss impacts.

Figure 9 represents the future year 2045 outputs of TransCAD modeling using inputs referenced earlier, to demonstrate the impacts to the regional network when the Lumber River Crossing is closed. As demonstrated in this scenario, removing access along US 74 substantially increases truck flows by more than 25% along the alternative parallel corridors of NC routes 87, 41, 211 and 904, in addition to north/south facilities like NC routes 242, 410, and NC 131. The red colored routes demonstrate a significant decrease in trips, while the green segments demonstrate a significant increase in trips, with corresponding thickness representing magnitude of volume change. This discharge of truck flow burdens the surrounding network, increasing safety risk due to reducing capacity, and creating inefficiency in the movement of goods throughout the region.

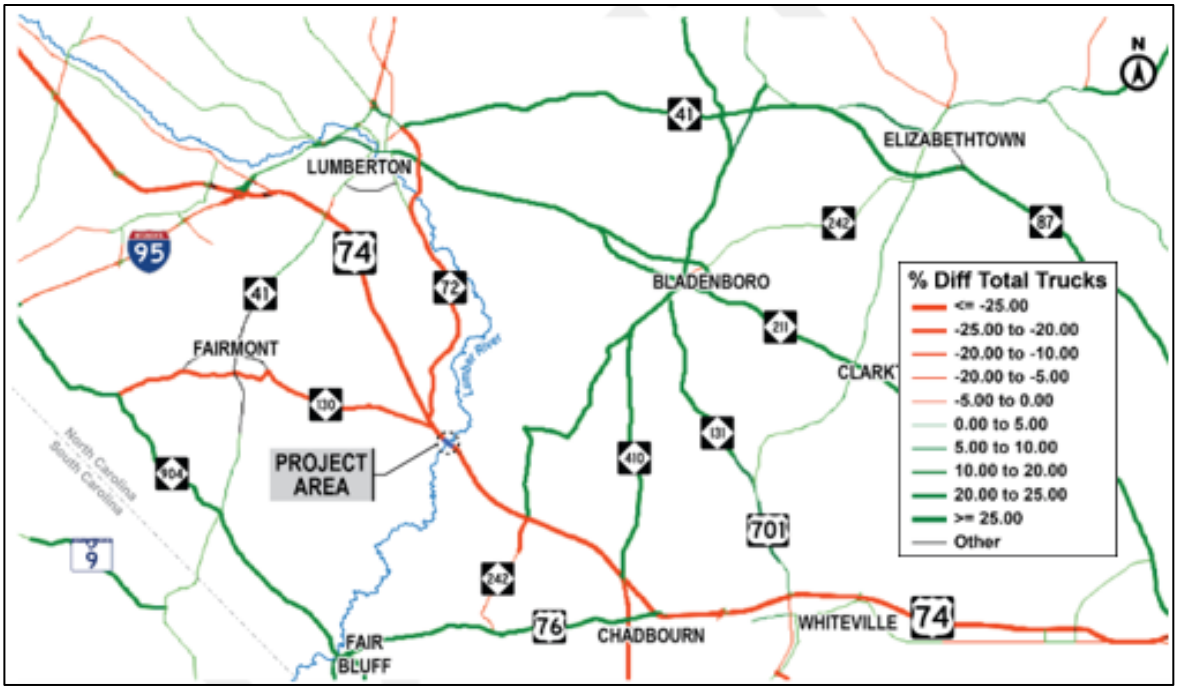

Figure 9: TransCAD model map for 2045 (without a roadway connection across the Lumber River)

C. Design Elements

NCDOT is seeking to minimize future maintenance costs at the US 74 Lumber River crossing due to large storm events. As such, the agency has invested in resilience planning and preliminary engineering efforts like the **US 74 Lumber River Crossing Hydraulic Design Alternatives Report**[6] to assess the river hydraulics. This assessment was conducted using HEC-RAS 2D to determine the potential for damage in future storm events and to identify suitable mitigation options to increase the integrity of the crossing.

The analysis determined that the Lumber River crossing experiences overtopping for both the 100-year and 500-year storm events, producing strong erosive water velocities on the shoulder of the eastbound lanes. In addition, the current velocities and flow patterns through the four sets of bridges results in increased susceptibility to scour and erosion along abutments and adjacent embankment.

The report also identifies three potential structural alternatives to mitigate damage in low-frequency storms, which vary in effectiveness and complexity. Table 2 summarizes the impacts of each alternative relative to NCDOT's resiliency concerns. Shoulder strengthening was identified as the preferred alternative due to its ability to withstand damage to the roadway surface effectively and at a lower cost.

[6] Attachment (2)

Table 2: Mitigation Options

Concerns	**Alternative 1:** Shoulder Hardening	**Alternative 2:** Guide Banks	**Alternative 3:** Raised Grade and Proposed Bridge
Road Closures (Overtopping)			X
Damage to Roadway Surface	X		X
Scour to Structures (Bridge Abutments)		X	

Shoulder strengthening entails the incorporation of either rock or a commercially available erosion control product into the existing shoulder to anchor the soil and resist shear stresses resulting from overtopping flow, which tend to promote and propagate scour across unprotected surfaces.

Erosion control product types considered include Articulated Concrete Block Mattresses (ACBM) and Turf Reinforcement Matting (TRM). Given the significant amount of overtopping flow and the variability of contributing factors along the crossing, preference is given towards High Performance Turf Reinforcement Matting (HPTRM) over standard TRM.

The 100-year maximum shear stress (4.7 pounds per square foot (lb./ft$^{2)}$) and velocity (10.0 foot per second (fps)) values seen in the existing model were used as the minimum criteria for commercially available erosion control products considered, based on anticipated future increases in water flow. A list of products was compiled and re-evaluated against the 500-year maximum shear stress (6.3 lb./ft^2) and velocity (10.3 fps). All products on the list, except for EnkaMat 7010, were found to meet or exceed these higher limits. Note that maximum velocity and sheer stress exceed design limits for Class II riprap, but it has been included for comparison. Aside from Class II riprap, the options should not present a hazard to motorists. After consideration of alternative improvement types, NCDOT has recommended use of Reinforced Soil Slope (RSS) with High Groundwater (No. 1803.01) as a starting point for development of a detail for shoulder strengthening as shown in Figures 10 and 11.

Figure 10: Articulated Concrete Block Mattress (ACBM) installation along shoulder

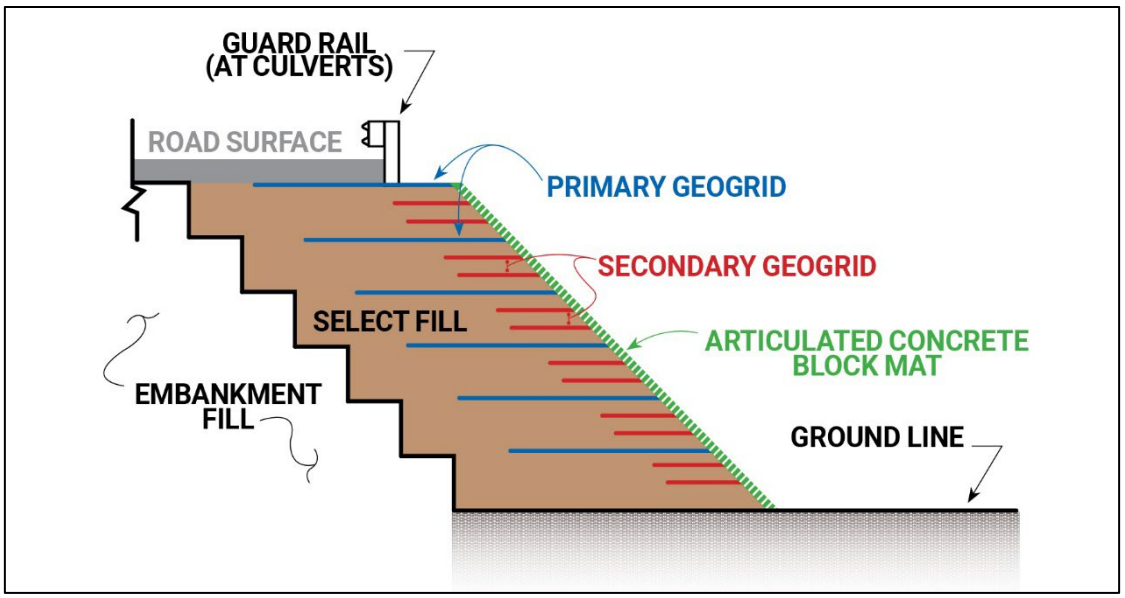

Figure 11: Reinforced Soil Slope (RSS) schematic for roadway shoulder

Although not a complex nature-based solution, the approach to this chosen alternative for improvement attempts, not to build out of or around natural impacts, but to limit environmental impacts through a less intrusive and passive application that accepts that the Lumber River will rise, and leaves a smaller grey imprint on the surrounding ecosystem while ensuring that travel will be disrupted for less of a duration of time than would be so, if the resilience improvement were not accomplished. NCDOT anticipates this approach will lead to lesser severe storm event-related maintenance investments in the future.

D. Public Engagement, Partnerships, and Collaboration

North Carolina's Strategic Transportation Corridors form the core network of multimodal passageways for the State. With the goal of connecting people, products, and places safely and efficiently, NCDOT routinely incorporates feedback from the community, especially since bringing this capital improvement through construction completion will innately require partnership with the community. NCDOT maintains a robust and growing public engagement portal as well as a public engagement toolkit, which provides practical information for project managers to reference as a means to better engage the public as part of a plan, project, or study process.

A public survey concerning US 74 was conducted between April and June of 2020 and garnered 638 participants and several thousand responses. The key findings are listed below.

- 36% of respondents shared that they use US 74 daily, followed by 26% weekly, and 26% monthly.
- 99% of respondents drive their own vehicle as primary mode of transportation.
- 47% of respondents say they have been impacted by flooding on US 74.
- Nearly 20% of respondents commute more than 20 miles to work or school.
- Less than half of a percentage of respondents have never used US 74.
- 36% of respondents use US 74 for activities that contribute to economic growth like shopping and dining, while 26% were commuting between work and home.
- 30% use US 74 for various other activities, such as visiting family, traveling, and vacation.

Similar to formerly completed highway projects, NCDOT plans to facilitate additional public engagement to gather diverse input during the design phase of the Project through the development of an interactive website. Upon award, NCDOT will design an interactive website similar to the one created for the U-5706 Eastern Rockingham Corridor Study, to provide opportunities for the community to learn about the Project including various study area maps, a project description, and informational videos to engage the public and receive input to consider during decision-making throughout the Project. The website will also include the Project highlights and history; recordings of public hearings; Project schedule; NCDOT contact information; and several ways to submit feedback.

Per North Carolina's Executive Order 80, NCDOT serves as a representative member on the North Carolina Climate Change Interagency Council. The duties of the Interagency Council are listed below.

- Recommending new and updated goals and actions to meaningfully address climate change
- Developing, implementing, and evaluating programs and activities that support statewide climate mitigation and adaptation practices
- Scheduling, monitoring, and providing input on the preparation and development of plans and assessments required by E.O. 80
- Reviewing and submitting these plans and assessments to the Governor

All state cabinet agency representatives, including NCDOT, participate in monthly meetings to collaborate, present, and inform on associated data and information, and to aid each other in aligning agency plans and goals with resiliency and E.O. 80. This partnership between NCDOT and the Council allows NCDOT to provide input and associated updates on planning, design, construction, and operation of this Project, as well as milestones and outcomes.

Additionally, the North Carolina Office of Recovery and Resiliency (NCORR) leads North Carolina's resiliency efforts in rebuilding smarter and stronger after natural disasters like Hurricane Florence. NCORR partners with local governments and state agencies to improve resiliency in social and financial systems that drive prosperity, human-made and nature-based infrastructure, ecosystems, and natural habitats that provide critical services and assets, as well as the health and well-being of North Carolinians statewide. In collaboration with NCDOT, the NCORR will facilitate and provide input to the resiliency efforts as part of this Project.

This Project is also being pursued in unison with the Lumber River Council of Governments which is working with NCORR's RISE Program to develop a portfolio of priority projects that strengthen regional resilience. This multi-phase effort includes a forward-looking vulnerability assessment, the identification of five to 10 high-priority projects, and a list of the actions needed to implement each proposed project. A diverse stakeholder partnership is guiding the Project to ensure that the scope of work reflects local priorities. This Project is cited in the NCORR's 2022 Climate Resilience Project for the Lumber River Region report. In addition, NCDOT has received multiple letters of support from groups and agencies in Columbus and Robeson Counties, the Port of Wilmington, the Lumbee Tribe, and federal, state, and local representatives, as included in Attachment 10.

Environmental planning and documentation will also be accomplished under NCDOT's programmatic agreement with FHWA for processing actions categorized as a CE. NCDOT also supports liaison positions within the US Army Corps of Engineers, US Fish and Wildlife Services, NC Division of Water Resources, NC Wildlife Resource Commission, and the NC State Historic Preservation Office that are dedicated to working on NCDOT Projects. Additionally, NCDOT has established multiple programmatic agreements with these federal and state agencies to further streamline Project delivery.

E. Equity and Environmental Justice

The Lumber River crossing is located at the convergence of three US Census Tracts (9305, 9616.01, and 9616.02) as shown in Figure 12. Based on the USDOT's Transportation Disadvantaged Census Tracts tool, the Project location, between Census Tracts 9305 and 9616.02, are both in transportation disadvantaged communities. The tool also indicated that residents of both tracts experience historic, health, economic, and resilience disadvantages. Tract 9616.01 is recognized as both transportation and economically disadvantaged. The USDOT Area of Persistent Poverty (AoPP) & Historically Disadvantaged Communities (HDC) tool also identifies these tracts as AoPP and HDCs.

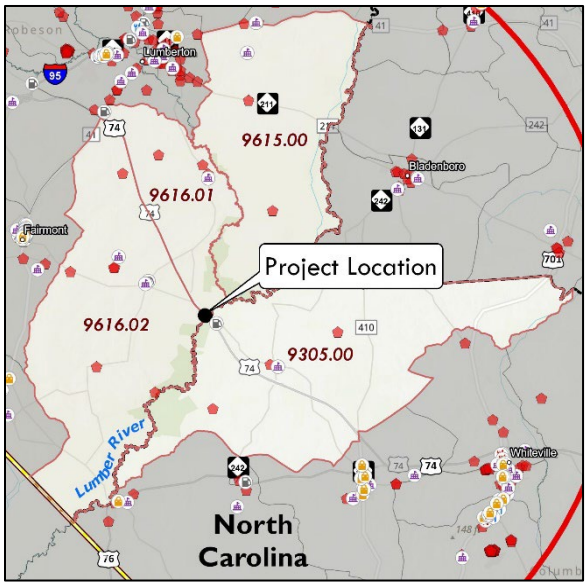

Figure 12: Census Tracts around the Project location

To the west of the Lumber River is the federally recognized tribal land of the Lumbee Tribe of North Carolina, defined as a State-designated tribal statistical area. Lumbee's land area is 2,041.2 square miles.

Because of its proximity to the project location, tract 9615 in Robeson County was included in the demographic analysis performed for this application. The following bullets document the demographic data for census tracts 9305, 9615, 9616.01, and 9616.02, according to 2020 ACS 5-year estimates for North Carolina.

A key Justice 40 finding of the analyses performed identified that **African Americans and Native Americans are 60% more likely to live in poverty** in these tracts when compared to Whites.

- 20% of individuals living in the four tracts live in poverty versus the State average of 14%.
- An additional 8% of total tract population lives at 50% of the poverty level.
- 27% of people living in poverty in the tracts are children versus the State average of 20%.
- Whites make up 52% of the population, followed by African Americans at 27% and Native Americans at 18% (data collected from the four census tracts from the Census Bureau and their established definitions of race).
- 25% of all African Americans live in poverty and 23% of the Native American population live in poverty, while only 14% of the White population live in poverty.

Seventeen percent of the sample total population here is 65 years older or more and 15% of the population identifies as disabled. Fifty-two percent of the sample population over the age of 16 is in the workforce. Nearly 90% of the workforce population over the age of 16 depends on a vehicle to commute to work while another 6.5% in this group share a ride to work.

In respect to labor categories, of the four combined tracts, the top five occupational industries here are not high wage industries and include education, health, and social services, where over 25% of the population is employed, followed by manufacturing at 15%, retail at 12%, construction at 10%, and food services at 6%.

There are 6,969 housing units and 5,962 households in the four combined tracts. The Average Median, Mean, and Average Per Capita household income in combined tracts is $41,060, $57,403, and $22,327, respectively. Nearly 25% of the total combined tract households have received food aid via the Supplemental Nutrition Assistance Program in the past 12 months. Forty-four percent of renting households spend 30% or more of their income on rent.

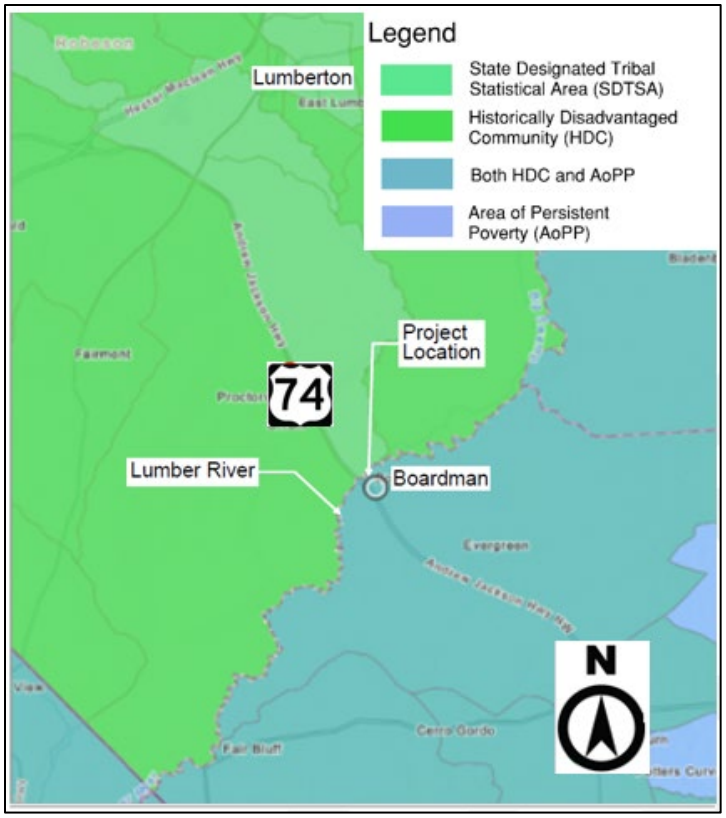

Figure 13: USDOT AoPP/HDC mapping tool

Two additional Project buffer analyses were performed using the FHWA Screening Tool for Equity Analysis of Projects (STEAP) to capture ACS 2016 to 2020 data. One buffer analysis targeted a 20-mile segment of US 74 with the Project location as the center point and a 0.5-mile buffer on both sides of the segment covering a 15-square-mile land area[7]. The data determined that 661 people and 184 families live within this segment, of which 22% have household incomes below $15,000, further supporting the understanding of prevalent poverty throughout the region.

A second analysis was performed that captured a 73-square-mile area consisting of the greatest population densities in proximity to the Project[8]. This dataset was determined to be the local population that would be most affected by a Lumber River crossing disruption. The population in this boundary was 8,476 with 3,047 households and 2,185 families. Thirty-four percent of these residents are Native American, while 23% are African American. Forty-three percent of these households maintain an income of less than $35,000 a year with a 20% poverty rate, 9% of which is in the Native American community.

F. Climate Change and Sustainability

The US 74 Project incorporates evidence-based climate resilience measures to reduce the impacts of climate disruptions, such as hurricanes and floods, on communities along the corridor. The Project will help reduce delay, which increases emissions during post-event recovery and reconstruction. Additionally, the Project incorporates carbon-reducing strategies by investing in an alternative that is less construction heavy, resulting in a smaller carbon footprint for the solution. As identified in the referenced corridor resiliency study and the demographic analysis performed for this application, this Project provides significant benefits to surrounding communities.

To avoid adverse environmental impacts to all resources, including but not limited to air quality, water quality, wetlands, and endangered species, NCDOT will complete the necessary National Environmental Policy Act (NEPA) planning, coordination, and documentation as part of the

[7] Attachment (3)
[8] Attachment (4)

Project. While NCDOT expects minimal environmental impacts from the Project, the Department will ensure that appropriate coordination occurs with the federal and state agencies. Once all NEPA-related data is collected and analyzed, and the coordinating agencies have come to agreements, the results will be included in the NEPA document.

G. Scheduling and Budget

In anticipation of a successful award, NCDOT has taken into consideration the project schedule for NEPA and design activities. The schedule assumes a prospective award announcement in early 2024 and an award funded with FY 2022 funds that would be obligated in the second quarter of 2024.

NCDOT would complete the NEPA Categorical Exclusion and 25% design in the third quarter of 2024 with the Federal Emergency Management Agency (FEMA) permitting, design/construction permitting, and final design completed through the first quarter of 2024. In the context of a successful application award, construction could be completed through the middle of 2025. Table 3 provides an approximate timeframe for the key milestones anticipated for the US 74 Flood Mitigation at the Lumber River Project.

Table 3: Estimated Project Schedule

US 74 Flood Mitigation at the Lumber River Schedule								
TASK	2024				2025			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Funds Obligated								
2. Complete Categorial Exclusion								
3. 25% Final Design Plans								
4. FEMA Floodplain Permitting								
5. Design/Construction Permitting								
6. Final Design Plans								
7. Construction								

As presented in Section II and Table 1, the requested PROTECT Grant is proposed to cover 80% of the planning, engineering, and construction costs of the section of US 74 at the Lumber River. The Project cost is estimated at $2,254,500 and NCDOT is requesting $1,803,600 of PROTECT funding, 80% of the total project cost. Matching funding will be provided by State transportation funding sources.

H. Innovation

This Project represents one investment of many that are taking place along the US 74 corridor that will employ innovative partnerships, technologies, and/or techniques to provide responsiveness to the public in extreme weather events. The 190-mile stretch of US 74 from Wilmington to Charlotte, NC connects I-95 to the southeast part of the State, transporting goods, freight, and people. To increase the region's resilience to climate change, the NCDOT worked to assess future vulnerabilities and explore adaptation and mitigation options. The "City Simulator tool," a newly developed modeling software, was used to create a corridor-wide simulation of future growth and disasters from present day to mid-21st century. NCDOT studied various scenarios as listed below.

- Where will future flooding be most damaging to infrastructure, productivity, and freight?
- What are the sea-level rise impacts?
- How might future climate impact disadvantaged populations?
- What actions will save system operation costs and reduce downtime?

The assessment discovered hotspots across the corridor where concentrated improvements will be the most beneficial. It found that hardening and elevating infrastructure should be the main ingredient in the resilience approach, but that additional actions, such as increasing redundancy in the road system for disadvantaged populations, will have synergistic effects.

As NCDOT's goal is to reduce the loss of life and reduce flood-related property damage with timely, accurate flood inundation data, the hydraulic design work performed for this Project, as well as the **US 74 Resiliency Study**, are only part of that effort by NCDOT. The Department has also invested considerable time and funds into the Flood Inundation Mapping and Alert Network for Transportation (FIMAN-T) and BridgeWatch. These resources help NCDOT better understand the roadway conditions and better inform and communicate extreme rain and flooding events to the public and local community.

Figure 14: Extensive flooding following Hurricane Florence, September 2018

FIMAN-T, a web-based tool, provides NCDOT officials and emergency management stakeholders with real-time and forecasted flood inundation depths along roads, bridges, and other NDCOT assets. FIMAN-T pulls from various datasets to provide

visualization and metrics for roadway inundation, bridge hydraulic performance, and identification of potentially impacted NCDOT assets.

BridgeWatch is also an online application service that allows NCDOT to proactively monitor floor levels and rainfall conditions conducive to flooding at valuable bridges and culverts. These internal tools, in combination with DriveNC.gov, allow DOT staff to send customized electronic alerts via cell phones, emails, application dashboards, etc. when roadways and bridges are experiencing dangerous or critical conditions.

In combination with the improved ability to communicate flooding conditions and hazards to residents in real time, these technologies also improve NCDOT's system resilience and advanced disaster preparedness. Recently, 23 new stream gauges have been installed along the US 74 corridor. These will also be added to both the FIMAN-T and BridgeWatch tools to provide real-time flood impacts to US 74 including whether overtopping is occurring or near to occurring at the Lumber River crossing.

IV. BENEFIT COST ANALYSIS (BCA)

The FEMA BCA Toolkit Version 6.0.0 was used to study the cost of the proposed shoulder improvements of this project against the cost of expected damage created by roadway overtopping in the absence of the improvements. Total costs were derived from two previous repair scenarios and multiplied by the frequency of overtopping events in the future. A 2-D hydraulic model was used to predict roadway overtopping beginning at and above the current 50-year storm intensity. The recurrence interval input was derived in consultation with North Carolina State University to advise on climate change projections relative to future storm event frequency. The work completed by NC State focused on greenhouse gas impacts to climate change and conservatively concluded that the current 50-year (2% annual chance) storm event intensity may be that of a 25-year (4% annual chance) storm event by 2070.

Based on the rural nature of the project location other traditional BCA inputs, such as property damage or local business impacts, were excluded from the analysis. However, per the FEMA BCA tool, additional inputs included basic geographic information, project type, project costs, and project life. To assess the value of these roadway improvement projects, inputs included the duration and mileage of one-way traffic trips impacted by the loss of the asset, in addition to the costs of expected damages from multiple storm

Figure 15: Repair to shoulder after Hurricane Matthew, October 2016

recurrences. The resulting **Benefit Cost Ratio is 1.59** for the proposed southern shoulder hardening of eastbound US 74. Please see Attachment #9 for all BCA related materials.

V. FHWA PRIORITY CONSIDERATIONS

A. Exceptional Benefits to Justice 40

The US 74 Flood Mitigation at the Lumber River Project is located between two federally designated Areas of Persistent Poverty and Historically Disadvantaged Communities. Multiple census data analyses were performed for this Project that identified significant poverty and disparity in economic outcomes for local residents. As discussed in Section III.E., the strengthening of this facility will produce benefits for the local population, including the ability to gain access more quickly to locations essential to ensuring sustenance after major flooding events, as well as ensuring access for critical services by emergency providers to members of the surrounding communities.

B. Workforce Development, Job Quality, and Wealth Creation

NCDOT employs several strategies in workforce development to provide quality jobs that lead to economic growth for both prospective employees and business partners, many of which are aligned with multiple PROTECT goals and will be integrated in conjunction with this Project.

For example, NCDOT's Business Opportunity and Workforce Development (BOWD) unit provides supportive services to certified Disadvantaged Business Enterprise firms through training, education, one-on-one technical assistance, and other services.

The BOWD unit utilizes supportive services funds received from FHWA to provide free or cost-effective services individually or in conjunction with other partner organizations, state agencies and businesses. A primary purpose of the supportive services effort is to increase the number of businesses that have a work specialty related to the highway construction participating in the Federal-aid Highway Program, in accordance with 49 CFR Part 23, and contribute to the growth and eventual self-sufficiency of participating firms.

Additionally, NCDOT's workforce development program is considered a model for other states to follow. It focuses on providing equal opportunity and access to all people and producing a professional transportation industry workforce that meets employer's demands. NCDOT's program aims to ensure women, minorities and other disadvantaged populations can take advantage of the agency's on-the-job training and other workforce development programs. The program has been expanded to include people with disabilities, as well as people who are about to be released from prison, veterans, and people from the State's poorest counties. NCDOT is also working to attract more members of the Native American community to work for the agency by collaborating with the N.C. Commission of Indian Affairs. The state transportation agency's workforce development programs focus on providing equal opportunity and access to all people and producing a professional transportation industry workforce that meets employer's demands.

NCDOT also hosts Highway Construction Trade Academies for adults and recruitment programs aimed at students in grade school that allows NCDOT to collaborate closely with important

stakeholders and partners, including the Carolinas Association of General Contractors, NCWorks, and community colleges throughout the state.

C. Construction Readiness

NCDOT will complete the NEPA, design, and permitting work in less than one year following funds being obligated by USDOT in order to advance quickly to construction.

NCDOT will complete a Categorical Exclusion (23 CFR § 771.117) to comply with NEPA. The anticipated impacts to jurisdictional waters of the US will fall under the USACE's nationwide permit thresholds. NCDOT will submit a pre-construction notification or voluntary notification as appropriate to confirm Section 404 authorization under USACE nationwide Permit 23 – Approved Categorical Exclusions. A Preliminary Jurisdictional Determination (PJD) package is also in place for the US 74 Lumber River crossing and expires in January of 2028; therefore, the Project can advance quickly with permitting upon NCDOT's concurrence with the design.

NCDOT manages hundreds of projects on an annual basis, and they have over 70 project managers that oversee all phases of project development, including planning, design, environmental studies, and construction. Experienced staff from the Project Development Division will lead the project from planning through design. To date, NCDOT has used consulting firms to complete the comprehensive US 74 corridor resiliency study and they are thoroughly familiar with the Project area, including developing alternative solutions to improve the roadway. NCDOT has also used a multi-disciplinary consultant team for the preliminary planning and design work. The firm was selected based on their technical abilities and have decades of experience completing highway and hydraulics design work in North Carolina.

The work that has already been completed includes the current topographic surveys and a two-dimensional hydraulic model. The data can be easily transitioned into the analysis tools needed for a FEMA No-Rise analysis. The two-dimensional analysis also included the alternative design solutions and the conceptual design of the chosen shoulder hardening solution. This conceptual design was used for the cost data included in this application.

For the construction, NCDOT will be advertising the work and it is expected to take nine months to complete the advertisement and construction. The project management team will come from the Construction Division for Division 6, who are local to the Project area and understand the challenges of the location.

Additionally, NCDOT has extensive in-house experience and staff capabilities to efficiently manage the application of PROTECT funds. Staff from the Division of Planning and Programming will be responsible for the grant management. Within the past few years, NCDOT has used federal grand funds for more than 10 projects including the recently awarded Mega Grant 'Strengthening Transportation Evacuation Resilient Lifeline by Improving Network's Grid' (STERLING) and Fixing Low Water Bridges for Emergency, Transportation, Technology, Equity, and Resilience Project (FLOW BETTER) RAISE Grant.

D. Funding Needs

NCDOT has established processes and programs for the allocation of federal and state transportation funds. Unfortunately, this project is not compatible with existing processes and programs – many of which are codified in state law. For example, the majority of funds available for purposes other than maintenance, operations, and repair are allocated through NCDOT's Strategic Transportation Improvement Program (STIP) prioritization process. This biennial process evaluates projects based on a number of objective criteria and allocates funds to the highest scoring projects. This process is then used to allocate PROTECT formula funds along with other federal and state transportation dollars.

Due to rising costs for projects funded in the previously adopted STIP, the North Carolina Board of Transportation delayed the approval of the last round of the prioritization process for approximately two years from August 2021 until June 2023 to use existing projects from previously adopted STIPs. The next STIP cycle will begin later in 2023 with funds being committed in 2026 for the fiscal years 2026 through 2035.

The US 74 Flood Mitigation at the Lumber River, as a standalone project, would not score high in the evaluation process because of its size relative to other prioritized projects throughout the state. And even if it were funded through the STIP, those funds would not be available for several years, upwards of 12, resulting in further potential impacts to the Project area.

Alternatively, if the Project remains part of the larger US 74 resiliency project, it will also take 10 to 20 years until it can be constructed and could wash-out multiple times over in the interim. Lastly according to NCDOT policy, it is not appropriate or eligible to use operations and maintenance funds for this type of project.

In summary, there is not a funding mechanism in the near term to support this important improvement. The STI process and applicable laws and policies that control how funds are allocated within North Carolina leave this Project stagnant without a clear path forward for funding to address the critical resiliency needs at the Lumber River.

The last time US 74 was significantly damaged and washed away was in 2018.

Historically, a hurricane makes landfall every three to four years in North Carolina, so they are due for one soon.

As discussed throughout this grant narrative, residents, businesses, and tourists that rely on this roadway need the improvements as soon as possible, which is only possible through the use of PROTECT funds or other federal discretionary grants.

North Carolina Flood Mitigation:
PROTECTing US 74 at the Lumber River