

BENEFIT-COST ANALYSIS METHODS SUMMARY

Whiteville Floodprint: Mollie's Branch Stream Restoration and Infrastructure Improvements
FY 2022 FEMA BRIC Grant Application

INTRODUCTION

A benefit-cost analysis was performed by the Coastal Dynamics Design Lab at North Carolina State University as part of the FY 2022 BRIC Grant application for the City of Whiteville. The purpose of the application is to support the implementation of nature-based solutions and infrastructure improvements along Mollie's Branch in Whiteville North Carolina. The proposed combination of "green" and "gray" infrastructure enhancements call for approximately 5,100 linear feet of floodplain restoration, four (4) roadway modifications (e.g., upgraded culverts) at locations where the stream crosses underneath existing roadbeds, and an expanded area of constructed wetlands within the Central Middle School recreational complex. These proposed mitigation activities will reduce flood-related impacts and damages from 10-year to 100-year flood events for residents along Mollies Branch.

The project is estimated to cost \$5,410,449 inclusive of construction and maintenance. FEMA's Benefit-Cost Calculator (V.6.0) was used to estimate the damage reduction for each of the impacted structures and the value of the project's social and ecosystem services. The inputs used to develop the BCA are outlined below and followed by a discussion of the findings.

METHODOLOGY

Modeled Damages - Residential and Non-Residential Structures

To assess the current expected flood damages and the expected damage reductions from the proposed mitigation activities, each structure currently impacted by flooding up to the 100-year flood event was input into the Benefit-Cost Calculator as a separate line item using 'Modeled Damages' from the 'Floodplain and Stream Restoration' module. Hydraulic modeling conducted in the fall of 2022 provided a detailed analysis of the water surface elevations for 10-, 25-, 50-, and 100-year flood events for current conditions and conditions after mitigation.

The following inputs and sources were used to complete the 'Floodplain and Stream Restoration' module for each of the structures:

INPUT	SOURCE
Project Cost	\$0 - each impacted structure was included only to estimate damage reduction from the mitigation action. The full cost of the project was included as a separate line item.
Lowest Floor Elevation	North Carolina Emergency Management: NCEM manages a dataset containing all building footprints in the state. The data was developed for the North Carolina Floodplain Mapping Program (fris.nc.gov) as part of its effort to modernize FEMA Flood Insurance Rate Maps (FIRM) statewide. Data for structures located within the SFHA includes accurate measure of FFE collected by laser inclinometer.
Hazard Probability Parameters: Flood	BCA Attachment 4: BCA_Whiteville_FEMA BRIC_HydraulicSummaryReport_Nov2022 Raw data from the hydraulic model was used to identify streambed elevations, WSEs (before and after mitigation), and discharge values for each structure.
Building Information	BCA Attachment 5: BCA_Whiteville_FEMA BRIC_PropertyTaxCards_Nov2022
Standard Benefits: Building	BCA Attachment 5: BCA_Whiteville_FEMA BRIC_PropertyTaxCards_Nov2022
Standard Benefits: Contents	FEMA BCA Default Values
Standard Benefits: Displacement	Each of the residential structures included in the analysis is currently occupied. The total number of building residents is not known but is at least one (1), so this value was used in this section. Since many of the structures are likely occupied by more than one resident, the benefits value for 'displacement' is likely underestimated by this module.

Professional Expected Damages - Floodplain and Stream Restoration

A separate line item was created in the Benefit-Cost Calculator to account for the ecosystem services benefits from the proposed mitigation actions. All of the project costs and maintenance costs were included in this section and the default PUL value (30 years) was used. Since the expected damage reduction for each impacted property had already been calculated as a separate line item, the 'Professional Expected Damages' sections were left blank, and only the 'Standard Benefits - Ecosystem Services' section was completed.

The following table summarizes the inputs and sources used to calculate ecosystem service benefits:

INPUT	VALUE	SOURCE
Project Area (Acres)	15.07 ac	Calculated from conceptual design (BCA Attachment 6: BCA_Whiteville_FEMA BRIC_Ecosystem Services_Nov2022) inclusive of limits of work for stream restoration, roadway modifications, and constructed wetlands
Urban Green Open Space (Acres)	1.95 ac	Estimated from conceptual design (BCA Attachment 6: BCA_Whiteville_FEMA BRIC_Ecosystem Services_Nov2022). The educational constructed wetlands, trails, and recreational open space around the Central Middle School site are considered 'Urban Green Open Space'.
Urban Green Open Space (Percent)	12.94%	---
Riparian (Acres)	9.79 ac	Estimated from conceptual design (BCA_Whiteville_FEMA BRIC_Ecosystem Services_Nov2022). All areas within the widened stream channel and the adjacent low-lying areas are considered 'Riparian'.
Riparian (Percent)	64.96%	---

RESULTS & DISCUSSION

Using the 3% discount rate per the 10/06/2022 memorandum, the combined damage reduction and ecosystem service benefits expected from this stream restoration project totaled \$7,999,738. With an estimated total project cost of \$5,410,449, the final benefit cost ratio (BCR) for the proposed scope of work was calculated to be 1.48, which establishes cost effectiveness for the project titled Whiteville Floodprint: Mollie's Branch Stream Restoration and Infrastructure Improvements.