Appendix G

Economics

Princeville, North Carolina

Flood Risk Management Integrated Feasibility Report and Environmental Assessment

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1.0 Introduction

1.1 Purpose and Scope

This section summarizes the economic information for the Princeville Flood Damage Reduction Feasibility Study. The study is being carried out under the Corps of Engineers' General Investigation (GI) program to develop and evaluate alternatives for implementing solutions to flooding and related problems for the Town of Princeville, Edgecombe County, North Carolina. The analysis identifies the extent of the economic impact from flooding with the existing project and, on a comparable basis, evaluates the range of Measures to increase project performance considered in the study. The analysis first requires a risk-based analysis of the flood problem under the existing condition (existing levee and floodwalls). The future without project condition is then determined, and finally a risk-based evaluation in terms of benefits, costs, and performance of various alternatives under the with-project condition is completed. This study is being cost shared by the Army Corp of Engineers – Wilmington District and the State of North Carolina – Department of Environment and Natural Resources.

1.2 References

This analysis was accomplished under the procedures outlined in the following: Economic and Environmental Principles and Guidelines for Water and Related Resources Implementation Studies (P&G); Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, dated 22 April 2000; ER 1105-2-101, Planning, Risk Analysis For Flood Damage Reduction Studies, dated 3 January 2006; and Risk-Based Analysis for Evaluation of Hydrology/Hydraulics and Economics in Flood Damage Reduction Studies (EC 1105-2-205), dated 25 Feb 1994.

1.3 Project Description

The project will consist of structural and nonstructural components to protect approximately 1061 structures. All flood-proofed structures in the voluntary nonstructural program will be provided protection to the 100-year level.

1.4 The Problem

The Flood Reduction Feasibility Study was initiated following flooding of Princeville in September 1999 by Hurricane Floyd. Princeville is built in the floodplain of the Tar River and has flooded and recovered several times in its history. A levee was completed along the Tar River in 1967 under Section 205 authority. This levee provided a level of protection two feet above the flood of record. However, the levee was overtopped by Hurricane Floyd, damaging all businesses and residences. The U.S. Army Corps of Engineers, Wilmington District (USACE) was directed to conduct a study with the goal of determining how to provide additional flood protection.

1.5 Authorization

The Princeville study is being conducted under the Water Resources Development Act of 1986, and in response to Public Law 106-246, dated July 13, 2000, which reads as follows:

"For an additional amount for "General Investigations", $3,500,000, to remain available until expended, of which $1,500,000 shall be for a feasibility study and report of a project to provide flood damage reduction for the town of Princeville, North Carolina, and of which $2,000,000 shall be for preconstruction engineering and design of an emergency outlet from Devils Lake, North Dakota, to the Sheyenne River: Provided, That the entire amount designated by Congress as an emergency requirement pursuant to section 251 (b)(2)(A) of the Balanced Budget and Emergency Deficit Control Act of 1985, as amended".

2.0 Existing Conditions

2.1 Study Area Location and Description

The Town of Princeville is a small community of approximately 2,100 residents, located in the east central area of Edgecombe County. The city limits encompass a 1.39 square-mile area in the alluvial floodplain on the left descending bank of the Tar River, immediately across the river from Tarboro, North Carolina; refer to Figure 2.1Project Location Map. The study area is located in the eastern portion of North Carolina in the 1st Congressional District. The Tar River basin lies entirely within the State of North Carolina, and has a drainage area of 2,140 square miles above the towns of Tarboro and Princeville. The total drainage area of the Pamlico-Tar basin is about 3,610 square miles. The basin begins in the Piedmont Plateau, extends in a southeast direction, crosses the "Fall Line", and traverses the Coastal Plain to the Pamlico River and then on to Pamlico Sound. It is approximately 160 miles long and has an average width of 30 miles. The basin is primarily an agricultural area, with some manufacturing and lumbering. Corn, tobacco, and cotton are the principal crops. Rocky Mount, Tarboro, Princeville, Greenville, Henderson, and Washington, are among the towns located in the basin. The Town of Princeville has the unique historic significance of being the first town chartered by African Americans in the United States. Newly freed slaves originally settled the area that is now Princeville, shortly after the Civil War, in 1865. In February 1885, the North Carolina General Assembly passed the act to incorporate the town of Princeville, making it the nation's oldest black incorporated town.

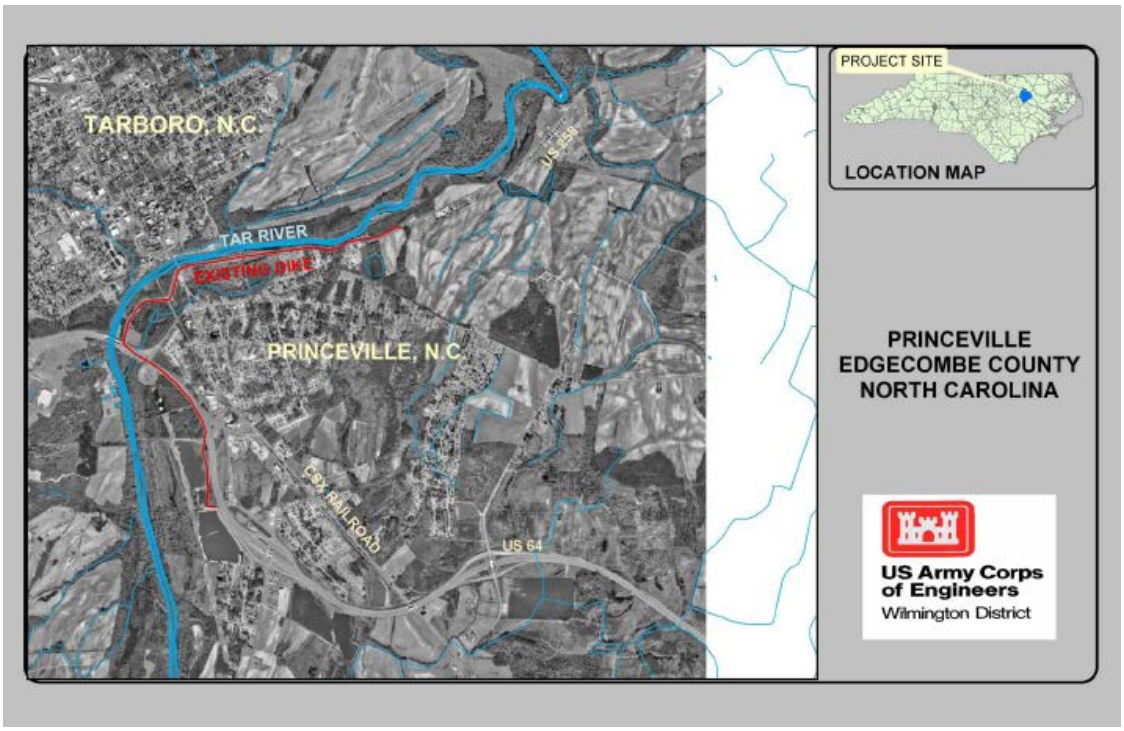

Figure 2-1: Princeville, North Carolina Study Area

2.2 Existing Socio-Economic and Demographic Characteristics.

2010 census statistics estimated the population in Edgecombe County was 56,552 persons, with 21,680 households and 14,842 families. The population density was 111.6 people per square mile (43/km²). The population estimate of 56,552 is an increase from the 2000 census of 1.7%. Of the 100 NC counties in 2010, Edgecombe ranked 50th in size and 95th in per capita income ($16,747).

Princeville's socio-economic climate mirrors that of rural Edgecombe County, perpetuating a trend of disparity in the social and economic climate between the state and the region.

Table 2.1: Local and Regional Population Comparisons,1990- 2010 Census

Year	Princeville	Edgecombe County	North Carolina
2010	2,082	56,552	9,535,471
2000	940	55,606	8,049,313
1990	1,652	56,558	6,628,637

Data from the corresponding US Census survey was used for population estimates

Edgecombe County has gradually lost residents since the late 1980s. This condition can be attributed to a decline in the farming economy and a shift to a service economy,

mainly concentrated in more urbanized areas. Table 2.1 displays the population trends from 1990 to 2010, for Princeville, Edgecombe County, and North Carolina. While this table shows a sharp decline in Princeville's population in 2000, it is important to note that roughly half of the populous was displaced by the impacts Hurricane Floyd. Table 2.1 indicates recovery beyond pre-storm population levels by 2010.

According to the U.S. Census Bureau Fact Sheet (2006-2010 Estimate), the majority of the population in Princeville was African-American, at 96.3 percent. 2.6 percent of the population was reported to be white, and the remaining percentage was reported as "other". The percentage of African-Americans in Princeville greatly exceeds those of the state, and nation, which were reported at 21.5 and 12.6 percent, respectively.

In 2010, there were 775 households in Princeville, out of which nearly 30% had children under the age of 19 living with them, 28% were married, living together, and 29.8% were non-families. 26.5% of all households were made up of single individuals and 11.5% of the population is someone who was 65 years of age or older. The average household size was 2.69 and the average family size was 3.25.

2010 Census data)states that the population of Princeville included 30.8% under the age of 19, 6.5% from 20 to 24, 21.4% from 25 to 44, 29.8% from 45 to 64, and 11.5% who were 65 years of age or older. The median age was 38 years. For every 100 females there were 81.5 males. For every 100 females age 18 and over, there were 76.9 males. The U.S. Census Bureau Fact Sheet (2006-2010 Estimate) indicates a median income for a household in the town of $21,066, which is 40.4% of the national average of $51,914. It also indicates a per capita income for the town of $12,024, which is 43.9% of the national average which is $27,334. About 38.9% of the population is below the poverty line; 2.8 times the national average.

Much of economic activity in Princeville revolves around production and service occupations, with some employed in sales and construction. Per the 2010 Census data, production, transportation and moving services accounted for 34.9% of employment followed by service occupations (28.9%), sales and office (18.0%), management, professional, and construction, extraction and maintenance. By comparison, in 2010, production, transportation and material moving were the largest of 20 major sectors in Edgecombe County. It had an average wage per job of $31,527. Per capita income grew by 19.0% between 1995 and 2005 (adjusted for inflation). Table 2.2 displays this regional and state employment distribution by activity.

Table 2.2: 2010 Occupation Distribution, by Percent

Occupation	Princeville	Edgecombe County	North Carolina
Management, professional, and related occupations	12.8	20.4	33.9
Service Occupations	28.9	18.8	16.0
Sales and office occupations	18.0	23.4	24.4
Farming, fishing, and forestry occupations	0	1.51	0.7
Construction, extraction, and maintenance occupations	5.3	5.1	10.6
Production, transportation, and material moving occupations	34.9	26.1	14.4

Source: 2010 U.S. Census

3.0 Future Without Project Conditions

3.1 Future Without Project Socio-Economic and Demographic Projections

North Carolina Office of State and Budget Management data for Edgecombe County, reported in 2010, shows a decline in the population, projecting to 2030. These estimated projections show a possible decline of around 20 percent of the population. While future without project conditions for the socio-economic climate of Princeville cannot be accurately estimated, it is assumed that the town will follow regional trends, and decline in population as migration to more urban areas continues. Table 3.-1 provides an interpolated projection of the population in Edgecombe County.

Table 3-1 Edgecombe County Population Growth Projections 2010 – 2030

	Population 2010	Population 2020	Estimated Population 2030	Population Change 2010 to 2020	Estimated Population Change 2020 to 2030
Edgecombe County	56,552	54,348	52,308	-2,204	-2,040

US Census Bureau

It is assumed that perpetuation of the existing conditions, and associated periodic flooding, will continue to impact agriculture, commerce and the existing infrastructure in

and around Princeville. Additional recovery costs associated with flooding will continue to be incurred.

The absence of project enhancement would most-likely perpetuate the existing demographic and social climate. It is conceivable that perpetuating the existing condition will cause adverse impacts, both tangible and intangible, to the community as a whole.

4.0 Project Alternative Comparison

4.1 Identification of Management Measures

Management measures can either be features (structural elements that require construction or assembly on-site) or activities (a nonstructural action) that can be implemented at a specific geographic site with the intention of causing a desirable change and results, preferably, in positive output. Management features that were identified to support project goals include the following:

- Levee Maintenance. This measure encompasses both features and activities. Maintenance of the existing levee and backflow prevention structures, along with the stop log structure at the railroad penetration, is critical to the integrity of flood risk management elements already in place. Maintenance over the life of the levee has been effective, and the levee remains in good condition. Repairs following Hurricane Floyd have settled in, and as a part of continuing maintenance, the crest elevation of the levee would be checked to ensure that throughout the alignment it maintains its original design height. Any low areas would be brought back to design height and stabilized. Backflow prevention structures would be maintained to ensure they can stop the intrusion of rising floodwaters from outside the levee. Proper function of the railroad stop log structure will be checked periodically, and the installation procedure kept up-to-date for quick implementation. Interior drainage measures will be maintained to insure the removal of excess water accumulated during storm events.

- Flood Warning and Evacuation Plan. This measure is a series of activities. A plan would be developed for reliable warning and evacuation procedures that would be implemented in the event of a flood. The plan would be coordinated with Town, County, State, and Federal agencies for establishment of communications and responsibilities for accomplishment of preparatory actions. This plan will be an extension of the existing state developed and maintained flood warning system.

- Flood Risk Management Education and Communication Plan. This measure is a series of activities. A plan would be developed for the purpose of helping the residents clearly understand the current and residual flood risks they face in Princeville. Various media would be used, including movies of how the town would flood with and without the project. Also, brochures, pamphlets, and hurricane season information packets. Information would be provided to help residents evaluate the value and cost of flood insurance for their properties, and encourage them to maintain it. Establish visual markers at points throughout the town to indicate various levels of flooding.

- Interior Drainage. This measure is composed of a series of features. Under existing conditions, rainfall runoff results in localized flooding in some areas of

Princeville. Measures such as pumps, discharge lines, and collection systems would be used to remove water collecting in these areas. This water, if not removed, could rise enough during storm events to cause flood damage to structures inside of the levee.

4.2 Initial Measures (Alternatives) Evaluated

The existing levee along the Tar River was constructed in 1967 in order to provide the Town of Princeville with flood reduction from a 100-year event. The 15,300-foot long levee is to be extended along Highway 54 and 254. But most of the levee would not be modified since it is already above the 100-year flood protection elevation. The extension to the existing structure may consist of the construction of earthen levees, installation of concrete and/or metal sheet piling flood control walls, installation of floodgates, possible raising of portions of the existing highways.

The Wilmington District presented a wide variety of potential structural and nonstructural damage reduction measures to the town, county, and state governments. These measures included upstream reservoirs, channel and bridge conveyance improvements, a bypass channel, levee modifications, flood proofing, elevation, and relocation. Many of these measures were dropped from further consideration due to social, environmental, or technical reasons before costs and benefits could be estimated.

The only measure remaining after preliminary screening was modification of the existing levee. Such a modification could include combinations of raising and lengthening the existing levee, but not to the elevation of requiring a ring levee, or reducing the conveyance of the Tar River floodplain. An increase in the existing levee elevation, for the main part of the levee, was determined to cause an increase in the river flood stages and so screened out. Further investigation of levee modification consisted of differing alignments to extend the levee to prevent flanking by floodwaters where the existing ground is low. Figure 4.1 provides an illustrative display of the array of alternatives considered.

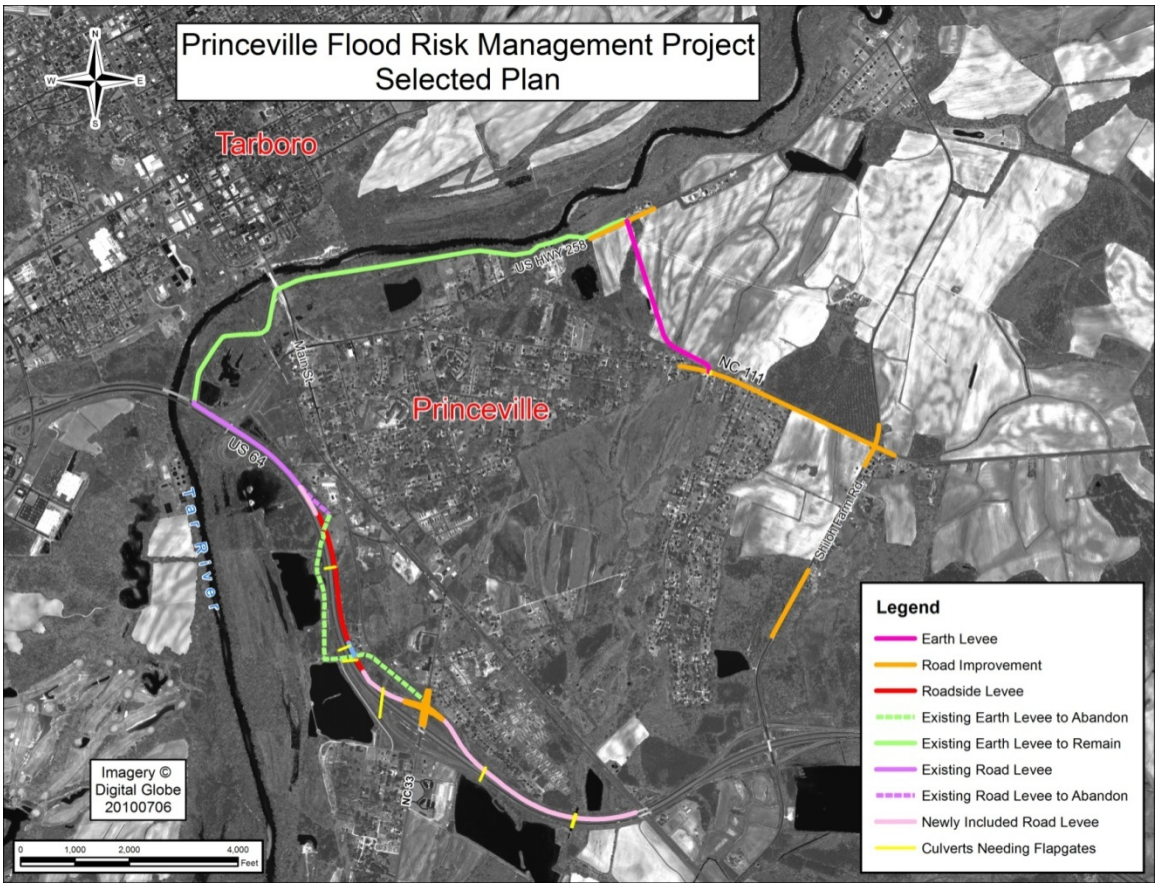

Figure 4-1, Proposed Flood Damage Reduction Alternatives, Princeville

4.3 Alternatives

The following are Alternative plans which have been formulated from various combinations of the Measures. All Alignments include Flood Warning and Evacuation Plan, Flood Risk Management Education and Communication Plan, Backflow devices S side, and interior drainage. Some measures would result in permanent relocation of all the residents out of the flood prone land that is now the town of Princeville.

4.3.1 Structural Measures

Upstream Reservoirs. This measure would involve construction of dams and reservoirs on the Tar River upstream of Princeville to retain floodwaters during major storm events, with the goal of reducing flood risk (both frequency of occurrence for a given level of discharge, and also stage) at Princeville.

River Channel Enlargement. This measure would involve deepening and/or widening the Tar River channel for the purpose of increasing capacity in the river thereby lowering flood risk at Princeville, by reducing stage and passing higher discharges.

Modify Existing Bridges. This measure would involve modifying the existing bridges along the Tar River at Princeville, to pass higher floodflows.

Bypass Channel. This measure would involve the construction of a high-flow bypass channel to convey floodwaters around Princeville and reduce river-source flooding within the town during storm events.

Ring levee. This measure would involve construction of a circular levee encircling the entire town of Princeville.

Drainage and Culvert Modification. This measure would involve installation of features that would reduce ponding caused when runoff (generally sheetflow) backs up behind the existing levee (i.e., within the Town of Princeville). When flood stage on the Tar River rises above the level of the existing drainage structures (culverts that pass drainage through the levee or highway embankment), they trap interior runoff behind the levee. In some instances these waters can rise enough to inundate nearby structures. Drainage modifications, including installation of back flow devices (i.e. flap gates), would prevent Tar River floodwaters from entering Princeville through existing drainage structures. Installation of back flow devices may in some cases exacerbate ponding created by runoff issuing from within the area blocked by the existing levee and highway embankment. Under higher floodflow conditions, ponding would occur, potentially requiring acquisition and relocation, or flood proofing to mitigate for induced flooding.

Flood proofing structures. This non-structural measure would involve flood proofing (for the design event, currently more than 900 structures), including foundation waterproofing, raised utilities, sealing doors, raising first floor, etc.

Raising the existing levee system. This structural measure would involve raising the crest of the existing levee for additional flood risk reduction and extending the north and south ends to prevent circumvention of the levee.

Existing Levee Extension. As discussed earlier in this report, the original levee, when constructed, terminated abruptly (without explanation) at both the northern and southern ends without transitioning the levee to high ground. Extensions of the ends of the levee could effectively prevent circumvention of the existing levee at its upstream and downstream ends. There are numerous alignments a northern levee extension could take to prevent circumvention of the levee beyond its northern terminus. The southern (downstream-most) end of the existing levee system would require consideration of the U.S. Highway 64 - North Carolina State Highway 33 interchange, to prevent circumvention of the levee from that low-point. A breakdown of potential northern levee extensions follows below.

Northern Extension of Existing Levee – Alignment A. This measure would consist of an extension of the northern end of the existing levee. This measure would also require addressing two locations at which natural drainage have to be routed through

new culverts under the levee extension. The levee extension would consist of about 8,650 feet of elevated roadway and a tie-in to the terminus of the existing levee. The segment of elevated roadway would comprise of an earthen berm with an approximately 45-foot top width, to accommodate two 12 foot lanes, 5-foot paved shoulders and 5-foot unpaved shoulders on each side, and guardrails as required; also, 3 to 1 side slopes, and a bottom width from 60 to 70 feet. The height of the fill would range from 5 to 6 feet. This measure would require the ramping of existing driveways in an adjacent subdivision up to the new roadway elevation. Approximately 33 residential or farm driveways, 6 commercial, and 2 subdivision streets would be affected. Two existing culverts which lie beneath U.S. Highway 258 (a 4'x4' reinforced concrete pipe) box culvert and Shiloh Farm Road (a 48" RCP culvert) would be replaced with new culverts. Toe drains would also be required along the fill to address changes in the drainage patterns.

Northern Extension of Existing Levee – Alignment B. This measure is identical to Alignment A, described above, except that a service road would be constructed along U.S Highway 258 to provide access to the homes in an adjacent residential subdivision. This would eliminate the need to ramp individual driveways up to the new road surface.

Northern Extension of Existing Levee - Alignment C. This measure is identical to Alignment A described above, except that a new service road would be constructed behind houses facing U.S. Highway 258. This would eliminate the need to ramp about 17 residential driveways up to the new road surface. The new service road would contain two 8-foot-wide lanes, and would be about 1425 feet long. It would be located in the backyards of the houses facing U.S. Highway 258, and would connect to a subdivision street that exits onto Shiloh Farm Road.

Northern Extension of Existing Levee – Alignment D. This measure would consist of raising about 4,200 feet of U.S. Highway 258 using the same configuration as Alignment A described above. In addition, to provide flood risk reduction to other nearby residential and commercial structures located northwest of U.S. Highway 258 and northeast of Shiloh Farm Road, the next 5,067 feet of the alignment would combine 2,887 feet of floodwall and 2,180 feet of earth berm. This berm-floodwall alignment would include an earth ramp for access to the raised portion of U.S. Highway 258, just south of a creek near the U.S. 258 and Shiloh Farm Road Y-intersection, on the north end of the project area. About 1,500 feet of Shiloh Farm Road would also be raised. About 8 residential or farm drives, 6 commercial drives, and one subdivision street would need to be ramped up to the raised roadways. The earth berm would have a top width of about 10 feet, 3 to 1 side slopes, and a bottom width varying from 60 to 80 feet. Interior drains would need to be constructed to remove water which would be trapped by the new berm and flood walls. Elevation of Shiloh Farm Road would require removal of the existing asphalt surface and sub base. New earth fill would then be placed on the road bed, overlaid by a new road surface. The top would be about 40 feet wide, and would contain two traffic lanes, paved and unpaved shoulders, and guard rails. To be used in conjunction with toe drains and the other surface drainage features, the addition of drainage pipes along the levee due to the sloping of the ground toward the levee would be required.

Northern Extension of Existing Levee – Alignment E. This would be substantially similar to Alignment D except this alignment would differ within the last 1,500 feet, at Shiloh Farm Road. Shiloh Farm Road would not be elevated; instead; a flood wall-and-berm feature would be constructed along the northeast side of the road. This would eliminate the need to ramp two drives and a street, and would eliminate the need to build a section of retaining wall at a residential structure.

Northern Extension of Existing Levee – Alignment F. This would be identical to Alignment E described above except that a floodwall would be constructed across U.S. Highway 258 from the 180-degree bend in the Tar River, to meet the Shiloh Farm Road end of the alignment as in Alignment E above. About 590 feet of floodwall would be required for that portion of the alignment, plus a ramp for US Highway 258 to cross the floodwall. The remaining 2,655 feet would consist of 1,290 feet of floodwall and 1,365 feet of berm constructed on the north side of Shiloh Farm Road. Six residential and six commercial driveway ramps would be required. Berms would have a top width of around 10 feet, 3 to 1 side slopes, and a bottom width that varies from 60 to 70 feet. The roadway rebuild would have the same configuration as Alignment D.

Northern Extension of the Existing Levee – Alignment G. This would start at the north end of the existing levee and run north on U.S. Highway 258 for about 4,150 feet to a point just south of a subdivision. It would then turn east along Cummings Lane at the edge of a field, for about 1,100 feet to the woods line, then north and east following the edge of the woods for about 1,200 feet, to Shiloh Farm Road. Shiloh Farm Road would be raised for approximately 600 feet to complete the alignment. The US Highway 258 portion would consist of a berm on the existing roadway with a top width of about 40 feet with two traffic lanes and paved and unpaved shoulders, and a bottom width around 70 feet. The section from U.S. 258 to Shiloh Farm Road would be a flood wall. The Shiloh Farm Road raising would be similar to the U.S. Highway 258 construction, but with a bottom width of about 60 feet. Because of an existing drainage ditch, a culvert with a backflow device would be required through the flood wall.

Eastern Extension of Existing Levee - Alignment H This measure would consist of a new levee which would tie in to the existing levee about 740 feet south of its north end. The alignment would cross U.S. Highway 258, requiring construction of a highway ramp. With the intent of minimizing impact farmland on the north side of the levee, a berm would then extend approximately 450 feet along a woods line to a point near an existing pond. The next 725 feet would be floodwall, due to proximity of the pond. Beyond the pond, the next 3,850 feet to N.C. Highway 111 would be a berm. The remainder of the levee, about 7,300 feet, would be constructed by elevating N.C. Highway 111. The berm would have a top width of about 10 feet, with 3 to 1 side slopes, and a bottom width that varies from 60 to 80 feet. Raising the road would require the removal of asphalt and sub base, then placing new fill on the road bed. The rebuilt road berm would have about a 40-foot top width and 3 to 1 side slopes, with a bottom width of about 60 feet. The roadway would have two lanes with paved and unpaved shoulders. The intersection of NC 111 and Shiloh farm Road would require the construction of a ramp for Shiloh Farm Road. Fifteen driveways and one subdivision street would have to be ramped up to the new road surface.

Eastern Extension of Existing Levee – Alignment I.

This measure consists of extension of the existing levee at the point of its current northern-most terminus along Highway 258, to the east, and then south, to its juncture with the approximate southern terminus of the project. The initial extension at the northern terminus would consist of a small extension at the height of the existing levee joining the levee to a new raised portion of Highway 258, which would bring all these features up to the same relative height (approx. elevation 49 feet NGVD). A new levee extension of the same height, of approximately 3,300 feet in length, would then extend from Highway 258 southeast and then east southeast, across existing farmland, to a juncture with Highway NC 111. At this point, a new levee section on which NC 111 would be re-constructed, would run along the existing roadway right-of-way,

approximately 3,350 feet to the intersection of NC 111 and Shiloh Farm Road. At this point a new levee segment, with re-constructed roadway, would run south approximately 400 feet along the existing right-of-way of Shiloh Farm Road to a point at which Shiloh Farm Road rises high enough not to require additional height. One levee/road-raising further south at a low point on Shiloh Farm Road would also be added, at a length of approximately 1,400 feet.

Reconstruct and Improve Stability, Condition and Safety of existing levee/levee. This measure would consist of specific improvements that might be performed to ensure that the existing levee was capable of being certified under current levee certification criteria, if found by geotechnical analysis, to be required.

4.3.2 Non-Structural Measures

Elevate and Raise Structures. This measure would consist of physically raising structures within the floodplain to an elevation above that floodflow elevation experienced during large flood events. This may be accomplished by raising foundations on piers or supports, raising structures on higher foundation walls, or installation of ground floors beneath the first floor living space. This largely depends on the area within the floodplain, and the depth of expected flooding.

Acquisition of Structures/Properties and Relocation of Residents. Reduction of flood risk might also be accomplished within the Town of Princeville by acquiring flood prone properties and relocating the residents to decent, safe and sanitary housing outside of the floodplain.

Flood Warning and Evacuation. Risk reduction in Princeville can also be achieved by installation of a flood warning system, which notified residents of rising floodwaters and potentially dangerous flooding, by klaxon or warning sirens. This gives people advanced warning in order to evacuate Town before serious flooding occurs, but does not reduce flood inundation damage to structures. The plan would be coordinated with the Town, County, State and Federal agencies for establishment of communications and responsibilities for accomplishment of preparatory actions. This plan would serve as an extension of the existing state-developed and –maintained Tar River flood warning system. The plan will identify proper times and elevations for modifications to residents in order to provide a safe and orderly evacuation. This measure would not provide any relief from structure and content damage.

Flood Risk Management and Communication. This measure consists of providing information and communication plans to advise local residents whether the area where they live is exposed risks of flooding, including depth of flow. General historical flood information or photos would provided; what range of risk they are exposed to; and the need to be flood ready (i.e., what they should do in planning for a future flood).

Zoning Changes. This measure consists of imposing zoning and land use controls on property and infrastructure development that reduce flood risk.

Floodplain Restrictions. There are a variety of flood plain restrictions that would reduce flood risk, and that would be imposed by the Town, County, or State. These include: constraints on construction or filling activities that would reduce the ‘storage capacity” for floodwaters in a floodplain: expectations that road access be maintained above (higher than) the flood level of a 1 percent chance flood event; codes that require that the first floor of a new building must be at a level at least one foot above the 1% chance flood level; and that changes, improvements, and additions to existing structures must meet current requirements.

Building Code Modifications/Restrictions. Higher levels of risk reduction can also be achieved by modifying local building codes, requiring any new construction of residential and commercial structures be either constructed with higher first floor elevations, or alternately, that those codes could also restrict building in the flood plain entirely.

During the plan formulation process, the viable alternatives were selected for analysis. Once these conceptual plans were identified, structure and real estate inventories were compiled for each of the relative footprints

4.4 Initial Evaluation of Alternative Plans

Evaluation of alternative plans is based primarily on a comparison of the future without project conditions to each of the with project alternative conditions. The benefits of the alternatives are measured as the net gain (change) in flood risk management benefits over the future without project conditions. The costs of implementing each of the alternatives are then compared with the net benefits provided by that alternative, using cost effectiveness criteria, as described in the Corps of Engineers Evaluation of Environmental Investments Procedures Manual IWR Report #95-R-1 Initial costs of the previously mentioned measures are listed in table 4.1 below:

Table 4.1 Summary of Planning Level Total Cost Estimates for Options & Measures

Options/ Measure(s)	**Total Planning Level Cost** (Approximate Present Value Dollars)[1]
Opportunity 1 – Eliminate Risk Through Acquisition and Relocation	$540,000,000
Opportunity 2 – Reduce Risk / Modify Existing Levee	
Northern Ext – Alignment A	$29,500,000
Northern Ext – Alignment B	$29,500,000
Northern Ext – Alignment C	$29,600,000
Northern Ext – Alignment D	$34,900,000
Northern Ext – Alignment E	$32,000,000
Northern Ext – Alignment F	$34,900,000
Northern Ext – Alignment G	$34,000,000
Eastern Ext – Alignment H	$28,800,000
Eastern Ext – Alignment I	$21,100,000
Opportunity 3 – Reduce Risk / Raise Existing Levee	
Raise Levee and Mitigate Induced Flooding Damages	$91 million, not including mitigation costs
Opportunity 4 – Reduce Risk / Large Scale Measures	
Upstream Dams & Reservoirs.	>$91,000,000, not including mitigation costs
River Channel Enlargement	>$50,000,000, not including mitigation costs
Modify Existing Bridges	>$15,000,000, not including mitigation costs
Bypass Channel	$150-$400,000,000, not including mitigation costs

Opportunity 5 – Non Structural Measures	
Flood proof Structures	$75,000,000 - $100,000,000
Elevate Structures by Raising (applies only to 25% of structures)	$24,000,000
Flood Warning and Evacuation	Will be updated as part of on-going State and local efforts (will use data from this report)
Zoning	Minimal; would be implemented with other measures
Floodplain Restrictions	Has been implemented by Town of Princeville
Opportunity 6 – Reconstruct Existing Levee	Determined not to be required at this time

4.5 Economic Survey Overview.

The data collection effort for the feasibility study was accomplished by GREENHORNE & O'MARA, INC accompanied by MA Engineering Consultants, INC., Cary, NC, to serve as the traditional (non GPS) survey crew. The logistics of data collection were coordinated and checked for completeness and efficiency.

At each structure:

- A "shot" was taken as close as possible to, but within ten feet (10') of the front door at the finished floor elevation;
- Additional shots were taken at the existing grade elevation adjacent to the front door, and at the lowest grade on the lot/parcel;
- Attribute data was entered into the data collectors pertaining to the structure's street address, status, condition and type;
- A digital photo was taken of the structure;
- A log sheet was completed as redundant data record and the digital photo file name was added;
- The structure was marked on a copy of the local GIS map to prevent duplicate locations;

The purpose was to provide horizontal and vertical data, as well as attributes describing a structure's type, status and condition, in a GIS SDSFIE STANDARD Geodatabase for use in the Princeville Flood Reduction Study.

4.6 Residential, Commercial, Agricultural and Public Economic Data Collection

Field survey data was collected for 1495 structures for residential, commercial, agricultural, and public entities within survey limits as defined by the Government within the town of Princeville, NC. Data included: finished floor elevation, adjacent ground elevation and lowest grade elevation. Attributes pertinent to each individual structure were logged consisting of the structure's status, type and condition. Where possible, data was collected employing the Global Positioning System/Real-Time Kinematic

(GPS/RTK) methodologies relative to NAD 1983 NC State Plane Grid and NAVD 1988, vertical. Traditional total-station survey instruments were used, calculating trig-elevations with horizontal locations, where overstory and other obstructions excluded the use of GPS/RTK. All total station work was based on control points set by GPS/RTK. A digital photograph was taken of each structure. All data was converted from the survey data collectors into GIS shapefiles using Leica and TDS software. Shapefiles were then loaded into the SDSFIE Standard Structures Geodatabase using standard GIS object loading procedures.

Most structures fall within the residential category, including: apartments, double-, single-wide mobile homes, brick, wood, and concrete homes. The other remaining structures include agricultural, commercial and public entities. Of the 1495 structures surveyed, 1061 structures were used to derive damages because survey results included items covered in structure values such as garages, barn, etc. The valuation of the structures used as inputs into HEC-FDA were based on tax assessments from 2010.

4.7 Determination of Valuation Methodology for Structures

Structure values are a critical source of risk and uncertainty in the stage-damage curve. It is used to directly determine the damage to the structure and indirectly to determine damage to the structure's contents. Depreciated replacement value is the appropriate measure of structure value for Corps studies. Structure value for residential, commercial, agricultural, and public facilities was based on a mix of information obtained directly from County Assessor's Office and estimates based on representative samples of other typical structures in the study area. Electronic files obtained from Edgecombe County that contained structure footprint data and land parcel data (including parcel valuation data) was used to assign values to most structures in the data inventory. For structures without assessed values an estimate of the structure value was based on representative samples of other typical structures.

4.8 Depth Damage Relationships

Commercial, Residential, Agricultural, and Public damages consist of physical inundation damages to structures and contents (equipment, inventory, etc.). During an in-progress review meeting, Corps experts advised the potential use of available generic depth-damage relationships if survey form data were not available. Curves developed and available from a recent New Orleans District were specifically suggested for evaluation of suitability for use in this study. The New Orleans District was contacted and it was determined that these curves were appropriate because flooding characteristics were similar (saltwater depth-damage, one week duration, high velocity, silt and debris), and both study areas covered urbanized and rural areas having a mix of residential, commercial, and industrial development with similar types of construction. The New Orleans District functions included measures of error needed in risk-based analysis. Depth-damage relationships used in this study were obtained from the following source(s):

Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVR) in Support of the Jefferson and Orleans Flood Control Feasibility Studies, (June 1996), U.S. Army Corps of Engineers, New Orleans District. Structure depth-damage functions and related uncertainties are presented for three different types of construction: metal frame, masonry bearing, and wood frame wall

structures. Content depth-damage functions and related uncertainties are presented for commercial, residential, agricultural and public property categories.

Application of the above depth damage relationship depended on structure type and construction characteristics. Residential structures were divided into single-double wide mobile homes, brick homes, concrete homes, wood homes and apartments. Other structures include commercial, public and agricultural. Commercial structures were categorized as masonry bearing walls. Depth-damage relationships were formulated for each structure type, for each content type, and for the following two hydrologic conditions: (1) riverine or rainfall flooding – short duration (one day) freshwater; and hurricane flooding – long duration (one week) saltwater. The New Orleans District depth-damage functions were applied to each damage category assuming a long duration of water in the Town of Princeville in the event of a storm.

Table 4-2 displays the distribution of study area damage categories: residential, commercial, agricultural and public entities.

Table 4-2 Percent Distribution of Damage Categories in Study Area

CATEGORY	PERCENT OF TOTAL STRUCTURES
Residential	92%
Commercial	3%
Agriculture	3%
Public	2%

4.9 Uncertainties about Economic Data

Economic uncertainties are associated with structure and content values, structure elevations, and depth-percent damage relationship. According to EC 1105-2-205, when using conventional survey equipment the assumed error is plus/minus 0.05 feet at 800' with a standard deviation of 3.0 percent, assuming that error represents a 99 percent confidence interval and assuming normal distribution. The standard deviation is used as one parameter in a normal distribution representing the first floor elevation of each structure. The mean value of the distribution is assumed to be the measured elevation. For this study, a standard deviation of 0.3 feet was used to define the uncertainty in the first-floor elevations. For all structures the value of the structures was assigned a standard deviation of 10 percent of the building value; the ratio of the value of the contents to the structure was allowed to vary with a standard deviation of 10 percent; and other/structure value ratio was given a standard deviation of 2.0.

4.10 Structure Elevations and Uncertainties

Structure depth percent damage curves obtained from New Orleans District for homes without basements was selected and used as appropriate for the type of structure (e.g. 1-story without basement, 2-story without basement, etc.) These curves were generic and were determined to be appropriate for use in the Princeville study based on similar nature of flooding. Content to structure value ratios were chosen based on the particular

structure depth percent damage curve used for the structure. For no basement residential structure, ratio was set at 30% of structure value for apartments and 50% for all other residential structures.

A similar function was prepared for each of the damage categories as follows: Ratio was set at 80% for commercial structures; and set at 50% for both agricultural and public structures.

4.11 Analysis Years

The future with and without project conditions are evaluated over a 50 year period of analysis. The study configuration in the HEC-FDA Flood Damage Reduction Analysis program requires selection of a base year and a future year during the period of analysis to define damage and project performance for specific time periods during the life of a project. The analysis year represent static time periods during which the hydrologic engineering and economic data must be developed for the analyses. The existing condition analysis year for the Princeville study is 2014. The future condition analysis years for Princeville study are 2015 for the base year (assumed to be the first year any proposed project would be implemented and in place) and 2065 for the future year. The expected annual damage for each year in the analysis period is computed, discounted back to present value and annualized to determine the equivalent value over the analysis period.

4.12 Damage Categories

The predominant land uses and investment in the study area are residential, commercial, agricultural, and public structures. In particular, agricultural structures not crops are considered for damage categories because information about crops planted were not available at the time of the survey. Potential flood damages are based on damages to structures and damages to contents, including inventory and equipment for commercial and public properties.

4.13 Damage Calculation Methodologies and Uncertainties

The feasibility phase analyses for the Princeville Flood Damage Reduction project employs the HEC-FDA program (version 1.2.4 November 2008) developed by the Hydrologic Engineering Center, for incorporation of risk and uncertainty in the analysis of alternatives. Eight water surface profiles were entered into HEC-FDA for the Tar River. The eight profiles included the 0.50, 0.20, 0.10, 0.04, 0.02, 0.01, 0.004, and 0.002 probability events. In addition to specific economic data uncertainties discussed in previous sections, the program allows quantification of uncertainties in the discharge-exceedance probability function for each reach, the stage-discharge function for each reach, and the aggregated stage-damage functions by category for each reach, and incorporates those uncertainties in the integration of hydrologic and hydraulic engineering and economic analysis of the with and without project conditions using the Monte Carlo simulation techniques.

Flood damages for various flood events are computed based on the level of investment subject to flooding, the beginning damage elevation, and the estimated damage to that investment with various depths of flooding. Values of investment subject to flooding, structure elevations, and foundation heights (to indicate the elevation at which first floor flood damages would be estimated to occur) along with associated uncertainties were

entered into the HEC-FDA program for each structure or groups of structures in the study area. Damage susceptibility functions and associated uncertainties for the various types of structures and contents determined as described in preceding paragraphs were also entered into the HEC-FDA program. The HEC-FDA program references each structure's first floor elevation or beginning damage elevation to the corresponding frequency event elevation at the reach index point. Individual stage-damage relationships at each structure for each investment category are then computed with risk and aggregated to the reach index location in the HEC-FDA program for integration of economic and hydrologic engineering data. Use of the HEC-FDA program for analysis facilitates the assessment of the tradeoff between risks and costs.

4.14 Existing Condition Physical Damages

Damages for the Princeville study consist of physical inundation damages to the residential, commercial, agricultural and public structures and their contents. Early analysis of each levee unit area indicated that if a levee failed, all of the protected area could be flooded. The protected areas vary in elevations between the upper and the lower reaches. Depending on the location of levee overtopping or failure, the stage interior to the levee may be different than the stage exterior to the levee, and this relationship has been accounted for in the analysis. Existing conditions flood damages are presented in Table 4-3.

Table 4-3, Existing Condition Damages, By Reach, By Frequency of Event, 2010 Dollars

	Damage Reach			Damage
Annual Exceedence Probability	Lower 1	Upper1	Upper2	Total
0.04	$4,357.96			$4,357.96
0.025	$12,113.23			$12,113.23
0.02	$15,519.94			$15,519.94
0.015	$18,661.19			$18,661.19
0.01	$22,761.80	$3,417.74	$28,604.41	$54,783.95
0.009	$23,801.18	$3,513.55	$25,829.75	$53,144.48
0.008	$24,947.55	$3,643.13	$27,209.45	$55,800.13
0.007	$26,244.94	$3,836.54	$28,799.44	$58,880.92
0.006	$27,743.11	$4,092.57	$30,692.60	$62,528.28
0.005	$29,598.21	$4,401.77	$32,997.88	$66,997.86
0.004	$3,633.32	$4,733.92	$35,848.25	$44,215.49
0.002	$48,528.94	$5,291.94	$41,941.21	$95,762.09
0.001	$64,737.55	$6,326.62	$45,962.73	$117,026.90

Under existing conditions damage to structures begins in the lower study reach at around the 25 year level. Damages in the upper and end reaches begin at or below the 100 year event. In Table 4-3 Estimated damage throughout the reaches ranges between 4.4 million, at the 25 year to over 100 million at the Floyd level events (between the 500 and 1,000 year events).

4.15 Comparison of Alternatives

Screening cost estimates and estimated construction periods for each of the Measures were provided by Cost Engineering and Specifications Section, Design Branch, Wilmington District, with input from other Product Development Team (PDT) members. Interest during construction (IDC) for each alternative was calculated based on the total first cost for each Measure, the starting and completion dates for each phase, assumed equal monthly expenditures during each phase, and the FY14 Federal interest rate of 3.50 percent. Appropriate funding was assumed available for each phase. Total first cost for each Measure includes the estimated construction cost, cost for lands, easements and rights of way, preliminary engineering and design cost, supervision and administration cost, and contingencies. Interest during construction calculated for each Measure was then added to the total first cost to derive the economic cost of each alternative. The economic cost was then annualized based on a 50-year life and a 3.5% interest rate. Table 4-4 contains the total cost associated with project implementation, given the above criteria, for the considered alternatives.

Table 4-4: Average Annual Costs of the Combined Measures in 2010 Dollars

Cost/Benefit Assesment							
	Without Project	Inc 1	Inc 2	Inc 3	Inc 4	Inc 5	Inc 6
a. Benefits (rounded)							
Average Annual Damages Prevented	$0	$297,000	$393,000	$573,000	$840,000	$1,093,000	$1,166,000
b. Cost (rounded)							
Initial Project Cost, Including Real Estate	N/A	$772,000	$5,696,000	$5,953,000	$18,608,000	$54,970,000	$56,228,000
Interest During Construction	N/A	$3,000	$234,848	$245,445	$767,000	$2,266,000	$2,318,000
Total First Cost	N/A	$775,000	$5,931,000	$6,198,000	$19,375,000	$57,236,000	$58,546,000
Average Annual First Cost	N/A	$33,000	$253,000	$264,000	$826,000	$2,440,000	$2,496,000
Annual O&M	N/A	$1,000	$10,000	$11,000	$57,760	$98,000	$100,000
Total Avg. Annual Costs	N/A	$34,000	$263,000	$275,000	$884,000	$2,538,000	$2,596,000
B/C		**8.74**	**1.49**	**2.08**	**0.95**	**0.43**	**0.45**

5.0 Project Benefits

5.1 Project NED Benefits

The project benefits are measured in terms of reduced damage at each (building) structure, for use in the economic analysis. For each combination of measures, the issue of primary concern is the difference between damage occurring with the measures in place, compared to the damage occurring without the measures. This comparison can be obtained by determining the flood damage for all structures in a damage reach, and then aggregating over the damage reaches to get expected damages for the project on an annual basis. Finally, after all aggregation is complete the project benefits can be defined by calculating the difference in damages with, and without, the measures in place. An alternative to this method is to consider the project benefits structure by structure, and then to aggregate those benefits over the project.

5.2 Net Benefits

Net benefits are measured as the difference between benefits and costs, where benefits are defined as the reduction in flood damage resulting from the project. Assessment of economic performance builds upon hydrologic, hydraulic, and geotechnical factors that enter into the assessment of engineering performance, plus the computation of flood damage to structures or other activity in the floodplain. While engineering performance is focused on risk at each damage reach, economic assessment is more complex, involving the integration of information at several spatial scales. In the case of Princeville there are three spatial scales of analysis. These are:

- Project scale at which all the economic analysis is summarized,
- Damage reach scales used for most analysis in HEC-FDA (flood damage assessment model), and
- Structure scale where the assessment of damage to structures is made.

The project is divided into 2 damage segments (Upper and Lower) and 3 hydrological reaches), containing 1018 structures, with most of the structures concentrated in the lower reach. In the study area. The Lower 1 reach begins at cross section 237457, approximately 1.25 miles south of where US 64 crosses the river and extends to cross section 244870. The Index location of Lower 1 reach is cross section 237457. The Upper 1 reach begins at this point and continues upstream to cross section 245644. The Index location of Upper 1 reach is cross section 245050. The Upper 2 reach continues to cross section 252004, with the Index location at cross section 252004. . HEC-FDA conducts a distribution based Monte Carlo probability simulation, in which 100 iterations of damaging flows are re-created to best ascertain damages to those structures. Four variables will be randomized for each structure: first-floor elevation, value of the structure, value of the contents, and other values of the facility. The results of these simulations are aggregated by damage category (e.g., single-family residential, commercial, agricultural and public). A “Without Project” run was also conducted through FDA to establish simulated project performance against existing conditions. For the purposes of this analysis, the damages will be represented as an aggregate number. This aggregated figure has then been compared to a “Without Project” condition to establish a benefit of project implementation. The costs used in this analysis are represented as an average annual cost (see Table 5-1), as are the benefits. These two figures, when compared, produce a benefit/cost ratio. For NED projects, the benefit-cost

ratio is the typical indicator of project performance. Plans with higher benefit-cost ratios indicate that a greater return is received for the investment. Table 5-1 displays these results. Additionally, Table 5-1 displays the results of an incremental analysis, using the NED plan as the base, to demonstrate the additional cost and benefits of implementing plans that deviate from the NED plan.

Table 5-1: Project Performance and Incremental Assessment of Annualized Costs and Benefits, Princeville NC Flood Damage Reduction, 2010 Dollars

Alternative	**AA Damages ($1,000)**	**AA Benefits ($1,000)**	**AA Cost ($1,000)**	**B/C Ratio ($1,000)**	**AA Net Benefits ($1,000)**
Without project	$1,167				
Alternative 1: W/Flap Gate Retro-fit- **Increment 1**	$871	$297	$34	8.74	$263
Alternative 2: W/ Flap Gate, plus Shoulder Levee & US64/NC33 fix **Increment 2**	$775	$393	$263	1.49	$130
Alternative 3: **Increment 3=** Increment 2, *plus* fixes to 1' higher increment	$595	$573	$275	2.08	$298
Alternative 4 (Increment 4)*: plus northern & eastern ext. & NC-111 & 258 raises	$328	$840	$884	0.95	($44)
Alternative 5: **Increment 5:**, plus 2 foot additional raise	$75	$1,093	$2,538	0.43	($1,445)
Alternative 6: **Increment 6:** plus 4 foot additional raise	$2	$1,166	$2,596	0.45	($1,430)

*Increment 4 is the selected plan, and uses updated (2013) costs for the selected plan only, which were deescalated back to 2010 price levels to make them compatible with the costs from the other array of alternatives

5.3 Identification of NED Plan

Because the project is located in a flood-prone area, the resulting Benefit-to-Cost Ratios of the plans constituted by the combined (levee alternative with flap gates) alternatives range from 0.39 to 1.5. Wilmington District has therefore approached this project from the standpoint that its justification would depend heavily upon Other Social Effects, and as such, may not result in a selected plan that matches NED Plan. Table 5-2 contains a cost and benefit summary of the selected plan, Alternative 4 (Increment 4).

Table 5-2: Cost and Benefit Summary of the Selected Plan, Princeville NC Flood Damage Reduction, 2010 Dollars

Selected Plan Cost & Benefit Summary	
Initial Cost	$18,608,000
Cost Year	2015
Construction Period	28 Months
Project Life	50 Years
Discount Rate	3.50%
Interest During Construction	$767,216
Total Initial Cost	$19,375,216
Average Annual Cost	$826,037
Annual Operation and Maintenance	$57,760
Total Average Annual Cost	$883,797
Average Annual Benefits	$839,960
Average Annual Cost, 2015 Dollars	$883,797
Net Benefits	($43,837)
Benefit Cost Ratio	**0.95**

6.0 Selected Plan

6.1 Plan Description

The selected plan will require realignment or abandonment of the southern segments of the existing levee system due to realignment of U.S. Highway 64. These segments were previously called “Dike B” and U.S. Highway 64. Additionally, the existing levee system

will be extended to the north and south to tie to high ground. The realignment and levee extensions will require the addition of flapgates at ungated culverts at eight (8) locations, addressing a low spot in the existing embankment height of U.S. Highway 64, addressing the existing U.S. Highway 33 underpass, through which floodflows can enter Town, and construction of levee segments in specific portions of and Shiloh Farms Road to prevent overtopping. All features combined would provide a greater than 95% probability of containing the 1% chance event. Structural and non-structural features are described below.

6.2 Structural Features

6.2.1 Segment 1

Segment 1 of the Selected Plan is a new levee segment consisting of an extension (or southern extension) of the existing southern levee downstream to high ground. It begins at the crossing of U.S. Highway 64 and Main Street and extends along U.S. Highway 64 approximately 5,000 linear feet in a northwesterly direction to the location of the on-ramp from N.C. Highway 33 to U.S. Highway 64. Two (2) drainage pipes within this new levee segment will require installation of backflow prevention devices.

The southern extension will require construction of new levee along the ramp alignment resulting in raising the road surface of the west bound off ramp and its intersection with N.C. Highway 33. The design of vertical curves will be in accordance with the NCDOT Highway Design Manual. The high point is proposed at the intersection in order to provide adequate safe sight distances. It is recommended that the speed limit be reduced from 45 mph to 35 mph along N.C. Highway 33 from Main Street through the U.S. Highway 64 interchange in order to minimize dangers related to drivers approaching the high point with sufficient stopping distance before the intersection. The NCDOT Division Engineer is willing to support the reduction in speed limit due to the residential development in this area.

6.2.2 Segment 2

Segment 2 includes abandonment of the existing southern levee (previously called “Dike A”), the realignment and extension of the southern portion of the U.S. Highway 64 levee segment. It begins at the end of Segment 1 and extends to the north to the existing northern levee reach near the westbound bridge abutment of U.S. Highway 64 over the Tar River. Four (4) drainage pipes within this realigned levee segment will require installation of backflow prevention devices.

The existing levee includes 3,650 linear feet of U.S. Highway 64 extending southeast from the existing northern levee segment. The Selected Plan includes utilizing U.S. Highway 64 for an additional 600 linear feet, construction of a new levee along the eastern shoulder of the highway as discussed below, and constructing approximately 950 linear feet of levee resulting in raising the on ramp road surface from N.C. Highway 33.

Realignment of the levee will require construction of 300 linear feet of flood wall and 2,900 linear feet of new earthen levee along the eastern shoulder of U.S. Highway 64 westbound lanes. The segment will include 3 horizontal to 1 vertical slopes, a 10’ top width set at increasing elevation per increment, installation of drainage pipe and structures between the levee and west bound lane, installation of guard rail 10 feet from the existing edge of pavement and construction of a trapezoidal ditch at the landward toe of slope.

6.2.3 Segment 3

Segment 3 includes the existing northern levee (previously called “Dike A”) from the west bound lane bridge abutment of U.S. Highway 64 over the Tar River approximately 9,700 linear feet east to the terminus at U.S. Highway 258. A centerline survey of the earth levee revealed minor depressions in the top of levee that must be raised to the adjacent elevations. Additionally, stability analysis indicates an approximately 400’ long, 16’ wide 18” deep stability berm be constructed at the inside toe of the existing levee segment.

6.2.4 Segment 4

Segment 4 includes extension of the existing levee at the point of its current northern-most terminus along Highway 258, to the east, and then south, to its juncture with the approximate southern terminus of the project.

The initial extension at the northern terminus would consist of a small extension at the height of the existing levee joining the levee to a new raised portion of Highway 258, which would bring all these features up to the same relative height (approx. elevation 49 feet NGVD). A new levee extension of the same height, of approximately 3,300 feet in length, would then extend from Highway 258 southeast and then east southeast, across existing farmland, to a juncture with Highway NC 111. At this point, a new levee section on which NC 111 would be re-constructed, would run along the existing roadway right-of-way, approximately 3,350 feet to the intersection of NC 111 and Shiloh Farm Road. At this point a new levee segment, with re-constructed roadway, would run south approximately 400 feet along the existing right-of-way of Shiloh Farm Road to a point at which Shiloh Farm Road rises high enough not to require additional height. One levee/road-raising further south at a low point on Shiloh Farm Road would also be added, at a length of approximately 1,400 feet. Raising the roadway surfaces will require upgrades to meet current design standards. This will include the widening of the paved lanes from 10’ to 12’, widening of the shoulder to include 4’ of paved shoulder and 4 feet of grassed shoulder, and installation of guard rail in accordance with the NCDOT Highway Design Manual.

Fifteen +residential and three commercial driveways and a sub-division entrance will be adjusted to accommodate the levee construction and road raise. The driveways are proposed to be constructed at up to a 10% grade having a minimal 10’ vertical curve in lieu of a single break point that could lead to grounding of the vehicle at the top or bottom of the slope.

The three main interior storage areas will be connected to drainage pipes penetrating the levee which will include backflow preventers. The interior drainage plan will be designed so that no structures will be flooded at the interior 1% annual chance exceedance flood event.

7.0 Regional Economic Development

7.1 Regional Economic Development Benefit Evaluation

The Regional Economic Development (RED) account is represented by employment created during construction, Employment created after construction, Agricultural

Production and Local Farm Tax Revenues. The benefits will be generated using IMPLAN multiplier programs and local tax rolls.

Employment during construction is based on IMPLAN output, which will be derived using construction costs. The alternative with the highest construction will create the greatest regional multiplier impact, while the “no action” alternative creates no additional regional benefits. Employment after construction is based on O&M costs. Greater O&M efforts generally require more manpower.

The larger footprint alternatives could conceivably take more agricultural land out of production, while the no action leaves all lands in production. The lands that are in production will continue to generate tax revenue. The “no action” alternative will remain the best for both agriculture related components in the RED account.