

Appendix D

Cost Engineering Appendix

Princeville, North Carolina Flood Risk Management Integrated Feasibility Report and Environmental Assessment

Appendix D: Cost Engineering

PRINCEVILLE, NC FLOOD RISK REDUCTION FEASIBILITY REPORT Edgecombe County, North Carolina

1. The Cost Engineering Appendix was prepared to describe the Current Working Estimate (CWE) for Selected Plan for the Princeville Flood Risk Reduction Plan, Princeville, North Carolina – Feasibility Report.

The Selected Plan chosen was based on a balance of and consideration of cost-effectiveness, minimization of impacts to the physical environment, cultural, and historical values.

2. The Selected Plan for the Princeville Flood Risk Reduction Project is summarized by 4 segments listed below. All four segments are identified in Figure 7.1 of Main Report (All elevations are NAVD 88). The existing alignment of the existing dike is shown in Figure 1.7 of the Main Report.

Segment 1: Extend Existing Levee Alignment by raise/elevate existing road surface of NC 33 highway at its intersection with ramps for HWY 64-WEST – See Figures 1.5 & 1.6 of Design Appendix

Intersection Raise-

- ~ Final elevation 47 ft
- ~Demo of existing asphalt pavement
- ~7,000 CY Earthwork Fill
- ~4,000 SY Asphalt Pavement
- ~300 LF of 24 inch diameter pipe
- ~3 Flap Gates for existing box culverts

Segment 2: Realign Existing Levee alignment by constructing new roadside levee along and offset from US HWY 64-WEST (northwest of intersection with NC 33 highway) - See Figures 1.7 & 1.8 of Design Appendix

Offset Levee -

- Final elevation 47 ft
- ~28,000 CY Earthwork Fill
- ~300 LF Flood Wall
- ~300 LF 24-inch Drainage Pipe
- ~3,000 LF 30-inch Drainage Pipe
- ~4 Flap gates for existing pipe locations

Segment 3: Existing Dike has low spots below elevation 50 ft which need to be raised. - See Figure 1.9 of Design Appendix

Existing Dike -

- Final elevation 48 ft
- ~600 CY Earthwork Fill and Stability Berm

Segment 4: Short raise/elevate extension of existing levee and road surface of US 258 (NC 122) highway; and, then construct new earthen levee beginning, and intersect, south of US 258 (NC 122) heading southwest about 3,300 linear feet (across existing farm land) until reaching NC 111. Then raise/elevate existing road surface of NC 111 highway, approximately 2-3 feet for about 3,350 linear feet southeast thru the intersection of NC 111 with Shiloh Farm Road. - See Figures 1.10 & 1.11 of Design Appendix

Highway US 258, New Earth Berm, & NC 111 -

- Final elevation 49 ft
- ~107,000 CY Earthwork Fill
- ~ 22,000 CY undercut excavation for new earthen levee
- Demo existing asphalt pavement
- ~ 20,000 SY Asphalt Pavement
- ~ 1,200 SY Asphalt Driveways
- ~ 11,500 LF Drainage Ditches/Swales
- Drainage Pipe and Flap Gates
- ~ 2,000 SY of Temporary Access Road

Segment 4 also includes raise/elevate existing road surface of Shiloh Farm Road Intersection with NC 111 and raise/elevate existing road surface of Shiloh Farm Road for about 1,400 feet southwest of the intersection with NC 111. See Figure 7.5 of Main Report.

Shiloh Farm Road Intersection and South Raise-

- Final elevation 49.3 ft
- Demo existing asphalt pavement
- ~2,800 CY Earthwork Fill
- ~5,100 SY Asphalt Pavement and Driveways

A suitable borrow area for earthwork fill has been investigated and identified about 4 miles southeast of the project at intersection of highways US 64 at Chinquapin Road (SR 1524). Borrow area is shown in Figure 7.7 of Main Report.

3. Construction period anticipated is for one Prime Contractor for 24 months beginning June 2021 and completion June 2023. Segment 1, Intersection at NC HWY 33 and HWY 64 ramps, was assumed to be constructed initially, allowing 6 months, and when work was not ongoing at Segment 4 highway work. This would reduce the interruption of traffic flow at 3 interchanges along US HWY 64 which would occur if Segments 1 and 4 were ongoing concurrently. Noting that there may be a 5 month manufacturing lead time

for large diameter flap gates has to be evaluated when considering other segment construction time periods. Segments 2, 3 and 4 (excluding Shiloh Road in Seg 4) may be constructed concurrent work, over a 14 month period, following Segment 1. Finally the Segment 4 part of Shiloh road and intersection with NC 111 could be completed in the final 8 months of construction.

4. After completion of the segment construction, operation and maintenance costs for annual inspection of dikes, mowing vegetation twice per year (\$15,900), and video inspection of all pipes/culverts every 5 years (\$42,000) will be required to assure integrity of the project.

5. The TOTAL CURRENT WORKING ESTIMATE (CWE) for the selected plan is \$13,159,000 October 2013 pricing (\$17,765,000 with 35 percent contingencies). Construction is estimated for a period of 24 months. The Project First Cost October 2015 is estimated to be \$18,607,000 with 35% contingency. The CWE fully funded to midpoint of construction JUNE 2022 is \$ 21,096,000 with 35 percent contingency. These costs are shown in the Total Project Cost Summary attached to this appendix.

Operation and Maintenance costs for visual inspection, mowing 2 times per year and video tape of pipe/culverts every 5 years are estimated to be \$2,888,000 with 25% contingency for 50 years (\$57,760/year avg).

6. All construction CWE's, OCT 1, 2013 price level, are shown in the attached MCACES (Microcomputer Aided Cost Engineering System) summary sheets. The summary sheets are formatted into a Code of Accounts framework for reporting. The costs included under each Code of Accounts are described below.

The Cost Estimates were prepared under guidance given in the Corps of Engineers Regulation ER 1110-2-1302, CIVIL WORKS COST ENGINEERING; ER 1110-1-300, Cost Engineering Policy and General Requirements; and ETL 1110-2-573 Construction Cost Estimating Guide for Civil Works.

7. CODE OF ACCOUNTS

CODE OF ACCOUNT 01 – LANDS AND DAMAGES: The detail estimated costs were prepared and furnished by the Real Estate Division, Savannah District as discussed in the Real Estate Appendix E.

CODE OF ACCOUNT 02 – RELOCATIONS: The detail estimated costs were prepared and furnished by the Real Estate Division, Savannah District as discussed in the Real Estate Appendix E.

CODE OF ACCOUNT 11 – LEVEES AND FLOODWALLS: This account includes project costs for mobilization and demobilization, temporary construction, clearing and grubbing, demolition of existing asphalt, embankment fill, traffic control, drainage

features, and vegetation. New pavement, striping, and guardrail are considered relocation and part of ACCOUNT 02 – RELOCATIONS.

Emphasis was placed on accuracy of costs during evaluation of alternative plans to develop the Selected Plan. The location and features of all areas in relation to the project are described in detail in the Engineering Design Appendix.

a. Evaluation of availability and suitability of construction labor, equipment and materials considered direct costs were based on similar work and production for embankments and highway construction. Project specific crews have been developed for use in estimating the direct costs of construction and compared to items using quotes or historical cost information where applicable. Crew members consist of selected compliments of labor classifications and equipment assembled to perform specific tasks. Productivity has been assigned to each crew reflective of the expected output per unit of measure for the activities listed in the cost estimate. Quantity takeoffs were developed and provided by the Project Development Team (PDT) members. Quantities were spot-checked and sub-quantities for the project were developed by the engineering design section.

b. It was assumed that the prime contractor would be an earthwork/grading contractor with subcontracting for pavement, drainage, landscaping, concrete and hauling; however, there are many prime contractors for pavement that are also large earthwork/grading contractors. Other assumptions are listed below.

- Preliminary site utility information has shown no water, sewer, or overhead electrical relocations necessary. There is always a chance further investigation may reveal some utilities which may have to be relocated. Costs for relocation or design for this infrastructure is not included in the estimate. The nature of the existing utilities introduces some risk and potential cost increase.
- Construction Staging Areas have not yet been identified for the various phases of the project but are not anticipated to be a significant cost in the rural environment.
- No temporary storage area is included for storing sheets temporarily during sheet pile installation.
- Preconstruction submittals and project closeout administration is also included in the estimate under mob/demob as lump sum.
- Construction Duration was estimated at 24 months for one contract. Temporary facilities to include phone, electric, toilet and grading are included. Water supply is not included with these facilities. Computers, personnel and other overheads are included as a percentage of direct costs. It is anticipated that these overhead costs will be further defined once staging location and construction phasing have been finalized.
- Clearing and grubbing is anticipated to be minor – and includes clear, grub and chip of on-site debris, hauling and disposal. It is anticipated that each acre will produce approximately 100 CY of debris.
- Removal by milling of existing asphalt pavement is included as necessary to prepare for raising roadway elevations. Hauling and disposal/reuse of pavement material is included. Costs for hauling are included for a location within a 25 mile radius of site. Re-use of existing asphalt was also assumed.

- Items that may be encountered but are not yet identified until further site investigation and planning are complete include: demolition of existing metal beam guard fencing, drainage appurtenances, and chain link fencing. In cases where the proposed construction has not been identified, demolition of miscellaneous structures was included as a lump sum cost allowance for any unknowns.
- Preparation of the borrow area is included in the estimate for topsoil stripping, stockpiling, final grading and seeding following construction.
- Anticipated temporary erosion control measures (silt fencing) are included in mobilization/demobilization costs. It is not anticipated that dewatering pumps or activities will be needed to excavate at the borrow area.
- Temporary shoring or stockpiling is included with the excavation required for the dikes.
- Hauling of excavated material is estimated using on-highway haulers – 16.5 LCY trucks. Resurfacing of the haul route are not anticipated or included in the estimate at this time.
- Earthwork placement costs include placement of borrow, compaction, shaping of embankment slopes and finished grading.
- It was assumed that sufficient material can be achieved from the borrow site. It was also anticipated that borrow site is contaminant free. Therefore, there are no costs in the estimate for handling or disposal of contaminated materials or excavation activities at additional sites. Preliminary investigation has revealed no borrow contamination.
- Estimate includes installment of new corrugated steel guardrail, terminal end treatments, and shaping of embankment 2' beyond the face of rail. Locations and lengths were determined by engineering design section.
- Signing and striping is included along roadways as needed. Quantities were determined by engineering design section.
- Costs for demolition of existing signs and relocation of existing signs are also included. Required sizes of highway signs have not yet been determined but costs are included in the estimate for small roadside signage. It is anticipated that any increase in costs for signage will be covered by the project contingency.
- The CWE includes stripping of topsoil and stockpiling on site for landscaping purposes. It is assumed that the existing material is suitable for proposed topsoil and will be used in seeding the area. Mechanical seeding is the anticipated method of seeding.
- Each drainage item includes costs for trenching, excavation, sand bedding, backfill, compaction, and placement/installation of drainage structure.
- It is not anticipated that any temporary shoring will be required for the installation of drainage features. Dewatering is not included or anticipated for the installation of drainage features.
- Concrete collars required for tie-ins to other structures are not separately priced and are deemed incidental to installation of the pipe. Manholes required solely for the purpose of access are not included in the cost estimate.
- It is assumed that all excavated trench material is suitable for backfill. It is anticipated that all excess material will be graded or disposed of on site.
- Graded swales include costs for only rough grading and finish grading. It is anticipated that excess material can be disposed of and graded onsite. Lined swales include 6" cast in place structural concrete.

- The CWE includes cost of driving steel sheet pile for the floodwall. It is not anticipated that clearing of the drive line will be required as clearing and grubbing is already included for the area. Crane pads are not included with this item. It is anticipated that access to the drive line can be obtained from US 64.
- It is assumed that the existing soils are suitable for using hammers to drive the sheets. It is not known if vibratory equipment will be used.
- It is assumed that groundwater is not contaminated and therefore, costs for specialized sealants for steel sheet pile joints are not included in the estimate.
- Assumed cast-in-place concrete will be used for the concrete cap. Costs are included for form work and form liner.
- The estimate includes costs of traffic control barrier at rental prices for the duration of each section of the project.
- While traffic barrier may not be the method of choice for the contractor, other detour items such as traffic delineators, temporary striping and signage may be used. The costs included in the estimate are anticipated to cover all temporary traffic control measures. When construction sequencing and planning is more defined, these costs may be further refined.
- Costs for aggregate base course are included in the estimate for paving. ABC at 8", 2" of bituminous stabilized course, 2" binder course and 2" surface wearing course.
- Additional or finish grading required for roadway paving is included in the earthwork embankment section of the estimate.

c. All costs were developed to reflect an October 2013 price level.

d. A contingency of 35% was included to represent unanticipated conditions and uncertainties not known at the time the estimate was developed. There is a better than average level of confidence because of the geotechnical investigations of borrows areas, similarities of other embankment fill projects, and the historical costs for highway construction. A contingency of 35% was assigned from a formal COST SCHEDULE RISK ANALYSIS (CSRA), using Crystal Ball software, completed during the ATR. The detailed Cost Schedule and Risk Analysis (CSRA) was developed through coordination with the Cost Center of Expertise in Walla Walla, Washington.

Details of the CSRA include Risk Register identification, project cost forecast range (+/-) of pricing to identify major risks are shown in Attachment to the Cost Engineering Appendix.

Major risks of uncertainty identified were inadequate project funding (multiple contract years vs a single contract), contract acquisition sequencing, final survey data (versus LIDAR data) to confirm final quantities, confirming existing roadway base suitability for levee operation, and general/typical risks for any contract such as pricing of materials, fuel, labor market fluctuations, etc.

CODE OF ACCOUNT 30 – PLANNING, ENGINEERING AND DESIGN: The costs included in this account were based discussions with those responsible for performing

activities prior to construction through contract award. This account includes plans and specifications, field investigations and surveys, cost estimates, environmental monitoring, contract acquisition, and project management. A 35% contingency was assigned to ACCOUNT 30 based on the formal CSRA, using Crystal Ball software, developed through coordination with the Cost Center of Expertise in Walla Walla, Washington.

CODE OF ACCOUNT 31 – CONSTRUCTION MANAGEMENT – The costs included in this account were based on a percentage of construction costs as discussed with those responsible for performing each activity. This account includes supervision and administration of the contracts by construction management, engineering during construction, project management, and contracting personnel during construction. A 35% contingency was assigned to ACCOUNT 31 based on the formal CSRA, using Crystal Ball software, developed through coordination with the Cost Center of Expertise in Walla Walla, Washington.

Table below shows the current project schedule following authorization of the project. The schedule assumes expeditious review and approval of the project through all steps, including authorization and funding, and as such is subject to change.

Activity	Date
Project Authorization (WRDA)	Dec 2016
Sign PPA	Dec 2017
Complete Real Estate Acquisition	Dec 2020
Complete Final Plans and Specs	Feb 2021
Award Construction Contract	May 2021
Begin Initial Construction	June 2021
Complete Initial Construction	June 2023
Begin Operation/Maintenance	Dec 2024
Complete Operation/Maintenance	Dec 2074

Table of Project schedule following authorization.

Princeville Flood Damage_OCT-21-2013

Alternative/Increment No. 4 - has 4 segments: -----This Estimate is the SELECTED PLAN. This increment includes the installation of flap gates included in Segment No. 1, as well as the construction of dike to Elevation 47 ft by raising of NC 33 ramps to elevation 47 ft, and minimal fill along low spots in Segment 3 existing dike to obtain even elevation of 48 ft. This increment involves constructing a new dike for Segments 2 and 4. The new Segment 4 dike is located at the northeast end of the existing dike beginning on US 258 heading south approximately 3,300 LF to the intersection at NC 111 at elevation 49. Then NC 111 will be raised 2-3 feet for about 3,400 LF southeast thru the intersection of NC 111 with Shiloh Farm Road. Shiloh Farm Road intersection will be raised to elevation 49 and about 1,400 LF will be raised on Shiloh Farm Road south of the intersection with NC 111 to elevation 49.3. Segment 2 dike is along and offset from US HWY 64 - WEST (northwest of the intersection with NC 33) and includes construction of a floodwall, drainage, and earthwork to elevation 47.

Estimated by JOHN C. CALDWELL
Designed by CE-SAW WILMINGTON
Prepared by John C. Caldwell

Preparation Date 10/21/2013
Effective Date of Pricing 10/21/2013
Estimated Construction Time 730 Days

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<u>Date</u>	<u>Author</u>	<u>Note</u>
2/10/2013	John Caldwell	New Project Note - See Cost Engineering Appendix for narrative AND contingency development.

<u>Description</u>	<u>Quantity</u>	<u>UOM</u>	<u>ContractCost</u>	<u>Contingency</u>	<u>ProjectCost</u>
Project Cost Summary Report			13,158,811	0	13,158,811
01 LANDS & DAMAGES	1	LS	503,036	0	503,036
02 RELOCATIONS	1	LS	2,231,263	0	2,231,263
11 LEVEES AND FLOODWALLS	1	LS	5,924,512	0	5,924,512
30 PLANNING ENGINEERING & DESIGN	1	LS	3,000,000	0	3,000,000
31 CONSTRUCTION MANAGEMENT	1	LS	1,500,000	0	1,500,000

<u>Description</u>	<u>Quantity</u>	<u>UOM</u>	<u>ContractCost</u>	<u>Contingency</u>	<u>ProjectCost</u>
Contract Cost Summary Report			13,158,811	0	13,158,811
1 01 LANDS & DAMAGES	1.00	LS	503,036	0	503,036
1.1 Aquisitions, Relocations, Land Payments	1.00	LS	503,036	0	503,036
1.1.1 01B Acquisition by PS	1.00	LS	315,000	0	315,000
1.1.2 01G Temporary Permit/License/ROE	1.00	LS	24,000	0	24,000
1.1.3 01R Real Estate Land Payments	1.00	LS	164,036	0	164,036
2 02 RELOCATIONS	1.00	LS	2,231,263	0	2,231,263
2.1 01 Aquisitions, Relocations, Land Payments	1.00	LS	2,231,263	0	2,231,263
2.1.1 01NOO Relocation Costs - Pavement, Signs & Guardrail	1.00	LS	2,186,263	0	2,186,263
2.1.2 01N00 Relocations - Agreements	1.00	LS	45,000	0	45,000
3 11 LEVEES AND FLOODWALLS	1.00	LS	5,924,512	0	5,924,512
3.1 11 01 LEVEES - SEGMENT 1 -----	1.00	LS	536,316	0	536,316

3.1.1 Mob/Demob & Site Preparation - Seg 1	1.00	LS	60,392	0	60,392
3.1.2 Temporary Construction - Seg 1 6mos	1.00	LS	60,333	0	60,333
3.1.3 NC 33 Dike (Raise NC 33 and Ramps) - Seg 1	1.00	LS	415,591	0	415,591
3.2 11 01 LEVEES - SEGMENT 2 -----	1.00	LS	2,290,242	0	2,290,242

3.2.1 Mob/Demob & Site Preparation - Seg 2	1.00	LS	128,837	0	128,837
3.2.2 Temporary Construction - Seg 2 12- mos	1.00	LS	70,092	0	70,092
3.2.3 Dike A-1 (Shoulder Dike on US 64) - Seg 2	1.00	LS	2,091,313	0	2,091,313
3.3 11 01 LEVEES - SEGMENT 3 -----	1.00	LS	60,920	0	60,920

3.3.1 Mob/Demob & Site Preparation - Seg 3	1.00	LS	21,455	0	21,455
3.3.2 Temporary Construction - Seg 3 1-mos	1.00	LS	6,158	0	6,158
3.3.3 Dike - Seg 3	1.00	LS	33,307	0	33,307
3.4 11 01 LEVEES - SEGMENT new Raise US 258 -----	1.00	LS	373,651	0	373,651

<u>Description</u>	<u>Quantity</u>	<u>UOM</u>	<u>ContractCost</u>	<u>Contingency</u>	<u>ProjectCost</u>
3.4.1 Mob/Demob & Site Preparation - US 258	1.00	LS	49,072	0	49,072
3.4.2 Temporary Construction - 3 mos	1.00	LS	23,605	0	23,605
3.4.3 Raise US 258	1.00	LS	300,974	0	300,974
3.5 11 01 LEVEES - SEGMENT new EARTHEN BERM ----- -----	1.00	LS	1,063,431	0	1,063,431
3.5.1 Mob/Demob & Site Preparation - NEW EARTHEN BERM	1.00	LS	69,518	0	69,518
3.5.2 Temporary Construction - 4 mos	1.00	LS	20,701	0	20,701
3.5.3 Dike NEW EMBANKMENT	1.00	LS	792,322	0	792,322
3.5.4 NEW Earthen Berm uNDERCUT --	1.00	LS	180,890	0	180,890
3.6 11 01 LEVEES - SEGMENT new NC111 ----- -----	1.00	LS	915,039	0	915,039
3.6.1 Mob/Demob & Site Preparation - NC 111	1.00	LS	129,240	0	129,240
3.6.2 Temporary Construction -5 mos	1.00	LS	27,542	0	27,542
3.6.3 NC 111 (Raise asphalt and driveways	1.00	LS	758,258	0	758,258
3.7 11 01 LEVEES - SEGMENT Raise Shiloh Farm Road Intersection ----- -----	1.00	LS	183,545	0	183,545
3.7.1 Mob/Demob & Site Preparation - Shiloh Farm Road	1.00	LS	21,070	0	21,070
3.7.2 Temporary Construction - 2 mos	1.00	LS	14,557	0	14,557
3.7.3 Raise Shiloh Farm Road Intersection	1.00	LS	147,918	0	147,918
3.8 11 01 LEVEES - SEGMENT Shiloh Farm Road South ----- -----	1.00	LS	205,740	0	205,740
3.8.1 Mob/Demob & Site Preparation - Shiloh Farm Road South	1.00	LS	42,073	0	42,073
3.8.2 Temporary Construction - 2 mos	1.00	LS	14,249	0	14,249
3.8.3 Raise Shiloh Farm Road South	1.00	LS	149,418	0	149,418
3.9 11 01 LEVEES - Borrow Area - Chinquapin Road Site ----- -----	1.00	LS	131,981	0	131,981
3.9.1 Site Development	1.00	LS	131,981	0	131,981

<u>Description</u>	<u>Quantity</u>	<u>UOM</u>	<u>ContractCost</u>	<u>Contingency</u>	<u>ProjectCost</u>
3.10 11 01 Temporary Access Road - For NC 111 Construction----- -----	1.00	LS	163,647	0	163,647
3.10.2 Temporary Construction - - 4mos	1.00	LS	163,647	0	163,647
4 30 PLANNING ENGINEERING & DESIGN	1.00	LS	3,000,000	0	3,000,000
4.1 30 23 Design & Construction Documents - - - - -	1.00	LS	3,000,000	0	3,000,000
4.1.1 PED	1.00	LS	3,000,000	0	3,000,000
5 31 CONSTRUCTION MANAGEMENT	1.00	LS	1,500,000	0	1,500,000
5.1 31 23 Construction, Project Mgt, & EDC - - - - -	1.00	LS	1,500,000	0	1,500,000
5.1.1 Construction, Project Mgt, & EDC	1.00	LS	1,500,000	0	1,500,000

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: PRINCEVILLE FLOOD RISK REDUCTION
PROJECT NO: PN 113918
LOCATION: PRINCEVILLE, NORTH CAROLINA

DISTRICT: SAW - WILMINGTON
POC: CHIEF, COST ENGINEERING, Lee Danley, PE
PREPARED: 10/21/2013

This Estimate reflects the scope and schedule in report; PRINCEVILLE FEASIBILITY REPORT

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST	CNTG	CNTG	TOTAL	ESC	COST	CNTG	TOTAL	Spent Thru: 1-Oct-13 K	L	COST	CNTG	FULL
		(\$K) C	(\$K) D	(%) E	(\$K) F	(%) G	(\$K) H	(\$K) I	(\$K) J			(\$K) M	(\$K) N	(\$K) O
02	RELOCATIONS	\$2,231	\$781	35%	\$3,012	3.8%	\$2,315	\$810	\$3,125	\$0		\$2,450	\$857	\$3,307
11	LEVEES & FLOODWALLS	\$5,925	\$2,074	35%	\$7,999	3.8%	\$6,148	\$2,152	\$8,300	\$0		\$6,949	\$2,432	\$9,381
CONSTRUCTION ESTIMATE TOTALS:		\$8,156	\$2,855		\$11,011	3.8%	\$8,463	\$2,962	\$11,426	\$0		\$9,399	\$3,290	\$12,688
01	LANDS AND DAMAGES	\$503	\$176	35%	\$679	3.8%	\$522	\$183	\$705	\$0		\$552	\$193	\$746
30	PLANNING, ENGINEERING & DESIGN	\$3,000	\$1,050	35%	\$4,050	8.0%	\$3,240	\$1,134	\$4,374	\$0		\$3,915	\$1,370	\$5,286
31	CONSTRUCTION MANAGEMENT	\$1,500	\$525	35%	\$2,025	3.8%	\$1,558	\$545	\$2,103	\$0		\$1,760	\$616	\$2,376
PROJECT COST TOTALS:		\$13,159	\$4,606	35%	\$17,765		\$13,783	\$4,824	\$18,607	\$0		\$15,627	\$5,469	\$21,096

Mandatory by Regulation	CHIEF, COST ENGINEERING, Lee Danley, PE
Mandatory by Regulation	PROJECT MANAGER, Pam Castens
Mandatory by Regulation	CHIEF, REAL ESTATE, Belinda Estabrook
	CHIEF, PLANNING, Elden Gatwood
	CHIEF, ENGINEERING, Greg Williams, Phd, PE
	CHIEF, OPERATIONS, Bob Sattin
	CHIEF, CONSTRUCTION, Dennis Lynch
	CHIEF, CONTRACTING, John Mayo
	CHIEF, PM-PB, Sam Colela
	CHIEF, DPM, Christine Brayman

ESTIMATED FEDERAL COST: 65% \$13,713
ESTIMATED NON-FEDERAL COST: 35% \$7,384
ESTIMATED TOTAL PROJECT COST: \$21,096

Mowing embankments twice per year and video tape culverts/pipes every 5 years
O&M OUTSIDE OF TOTAL PROJECT COST: \$2,310
25% CONTINGENCY \$578
TOTAL for Years 2024 THRU 2074 \$2,888

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: PRINCEVILLE FLOOD RISK REDUCTION
 LOCATION: PRINCEVILLE, NORTH CAROLINA
 This Estimate reflects the scope and schedule in report; PRINCEVILLE FEASIBILITY REPORT

DISTRICT: SAW - WILMINGTON
 POC: CHIEF, COST ENGINEERING, Lee Danley, PE
 PREPARED: 10/21/2013

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 10/21/2013		Program Year (Budget EC): 2016										
		Effective Price Level: 1-Oct-2013		Effective Price Level Date: 1 OCT 15										
		RISK BASED												
WBS	Civil Works	COST	CNTG	CNTG	TOTAL	ESC	COST	CNTG	TOTAL	Mid-Point	INFLATED	COST	CNTG	FULL
NUMBER	Feature & Sub-Feature Description	(\$K)	(\$K)	(%)	(\$K)	(%)	(\$K)	(\$K)	(\$K)	Date	(%)	(\$K)	(\$K)	(\$K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	PHASE 1 or CONTRACT 1													
02	RELOCATIONS	\$2,231	\$781	35%	\$3,012	3.8%	\$2,315	\$810	\$3,125	2019Q1	5.8%	\$2,450	\$857	\$3,307
11	LEVEES & FLOODWALLS	\$5,925	\$2,074	35%	\$7,999	3.8%	\$6,148	\$2,152	\$8,300	2022Q3	13.0%	\$6,949	\$2,432	\$9,381
							\$0							
	CONSTRUCTION ESTIMATE TOTALS:	\$8,156	\$2,855	35%	\$11,011		\$8,463	\$2,962	\$11,426			\$9,399	\$3,290	\$12,688
01	LANDS AND DAMAGES	\$503	\$176	35%	\$679	3.8%	\$522	\$183	\$705	2019Q1	5.8%	\$552	\$193	\$746
30	PLANNING, ENGINEERING & DESIGN Project Mgt , Engr, VE, EDC, P&S	\$3,000	\$1,050	35%	\$4,050	8.0%	\$3,240	\$1,134	\$4,374	2020Q3	20.8%	\$3,915	\$1,370	\$5,286
31	CONSTRUCTION MANAGEMENT 10.0% Construction Management	\$1,500	\$525	35%	\$2,025	3.8%	\$1,558	\$545	\$2,103	2022Q3	13.0%	\$1,760	\$616	\$2,376
	CONTRACT COST TOTALS:	\$13,159	\$4,606		\$17,765		\$13,783	\$4,824	\$18,607			\$15,627	\$5,469	\$21,096

**PRINCEVILLE FLOOD DAMAGE REDUCTION,
EDGECOMBE COUNTY, NORTH CAROLINA
COST AND SCHEDULE RISK ANALYSIS
(CSRA)**

Prepared by:

U.S. Army Corps of Engineers,
Wilmington District

Supported by:

U.S. Army Corps of Engineer
Walla Walla Cost MCX

Date: October 2013

Princeville Flood Damage Reduction Report

Contingency on Base Estimate	80% Confidence Project Cost
PROJECT FIRST COST ESTIMATE ->	\$13,158,810
Cost Contingency Amount ->	\$4,605,584
Estimated Project First Cost Cost (80% Confidence) ->	\$17,764,394

Contingency on Schedule	80% Confidence Project Schedule
Base Project Schedule->	24.0 Months
Schedule Contingency Duration ->	20.2 Months
Project Schedule Duration (80% Confidence) ->	44.2 Months

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence. A parallel process is also used to determine the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to an estimate (cost or schedule) to allow for items, conditions, or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The project Cost Contingency at the 80% confidence level is 35%. This level was established by analyzing the different cost risk factors that affect the project. Cost contingencies can be either positive or negative. The cost sensitivity chart demonstrates relative cost contingency of individual risks for the initial construction.

Specific schedule risk derived from team's analysis was based mostly on lack of adequate funding to allow construction under one contract. If construction was not funded for one contract (24 month duration), then construction period could be as much as 44 months. Schedule risks for the construction window were assessed for their impacts to cost and added to the cost contingency for the project.

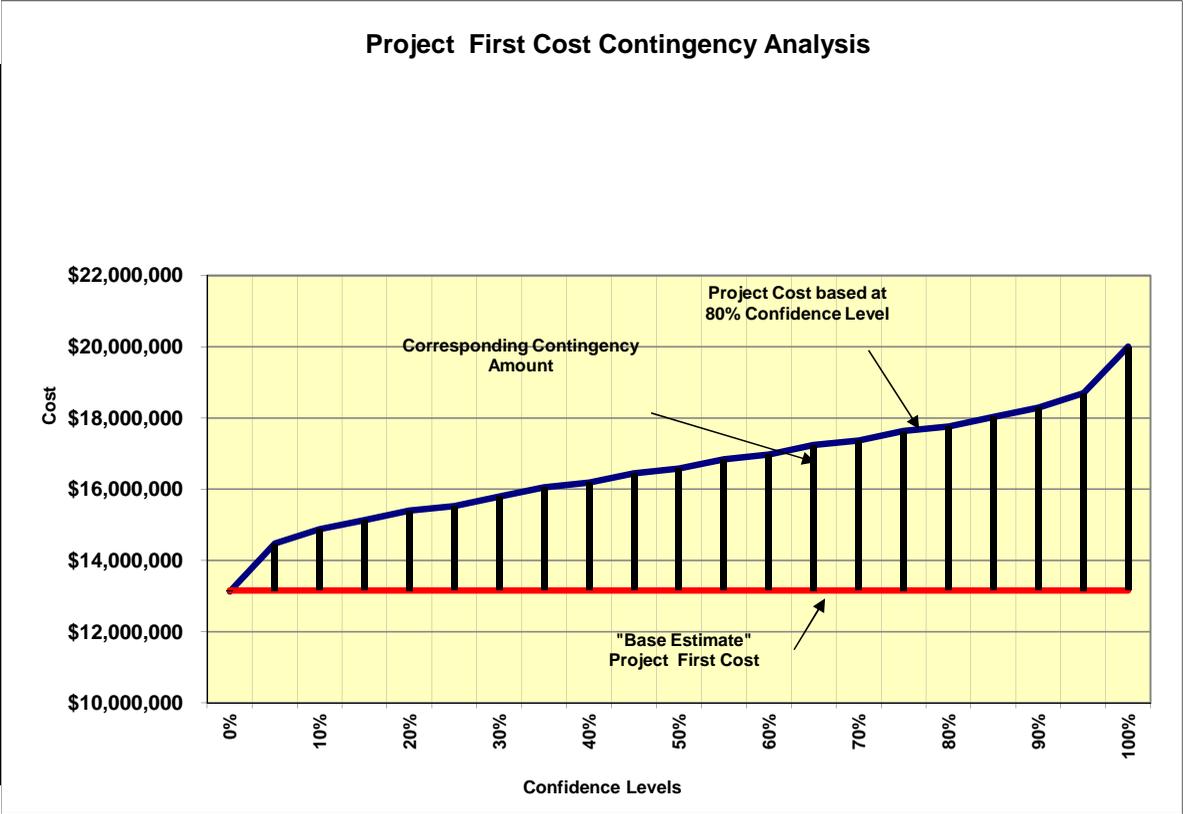
The following tables show the results for cost and schedule risks with various confidence levels. The 80% confidence level, 35% contingency, has been included in the final recommended plan.

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

PROJECT FIRST COST BASE ESTIMATE	\$13,158,810		
Confidence Level	Project First Cost	Contingency	Contingency %
0%	\$13,132,492	(\$26,318)	0%
5%	\$14,474,691	\$1,315,881	10%
10%	\$14,869,455	\$1,710,645	13%
15%	\$15,132,632	\$1,973,822	15%
20%	\$15,395,808	\$2,236,998	17%
25%	\$15,527,396	\$2,368,586	18%
30%	\$15,790,572	\$2,631,762	20%
35%	\$16,053,748	\$2,894,938	22%
40%	\$16,185,336	\$3,026,526	23%
45%	\$16,448,513	\$3,289,703	25%
50%	\$16,580,101	\$3,421,291	26%
55%	\$16,843,277	\$3,684,467	28%
60%	\$16,974,865	\$3,816,055	29%
65%	\$17,238,041	\$4,079,231	31%
70%	\$17,369,629	\$4,210,819	32%
75%	\$17,632,805	\$4,473,995	34%
80%	\$17,764,394	\$4,605,584	35%
85%	\$18,027,570	\$4,868,760	37%
90%	\$18,290,746	\$5,131,936	39%
95%	\$18,685,510	\$5,526,700	42%
100%	\$20,001,391	\$6,842,581	52%

Project First Cost Contingency Analysis

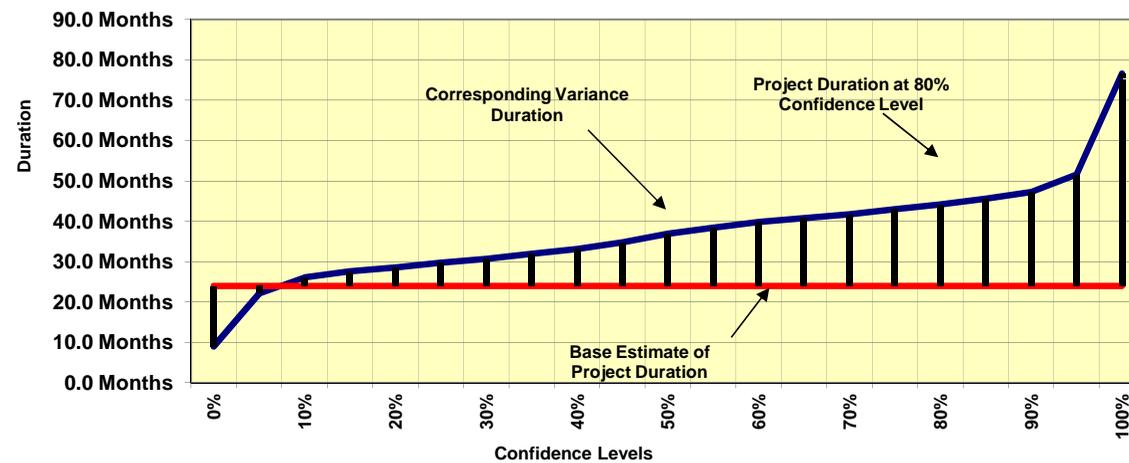


- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

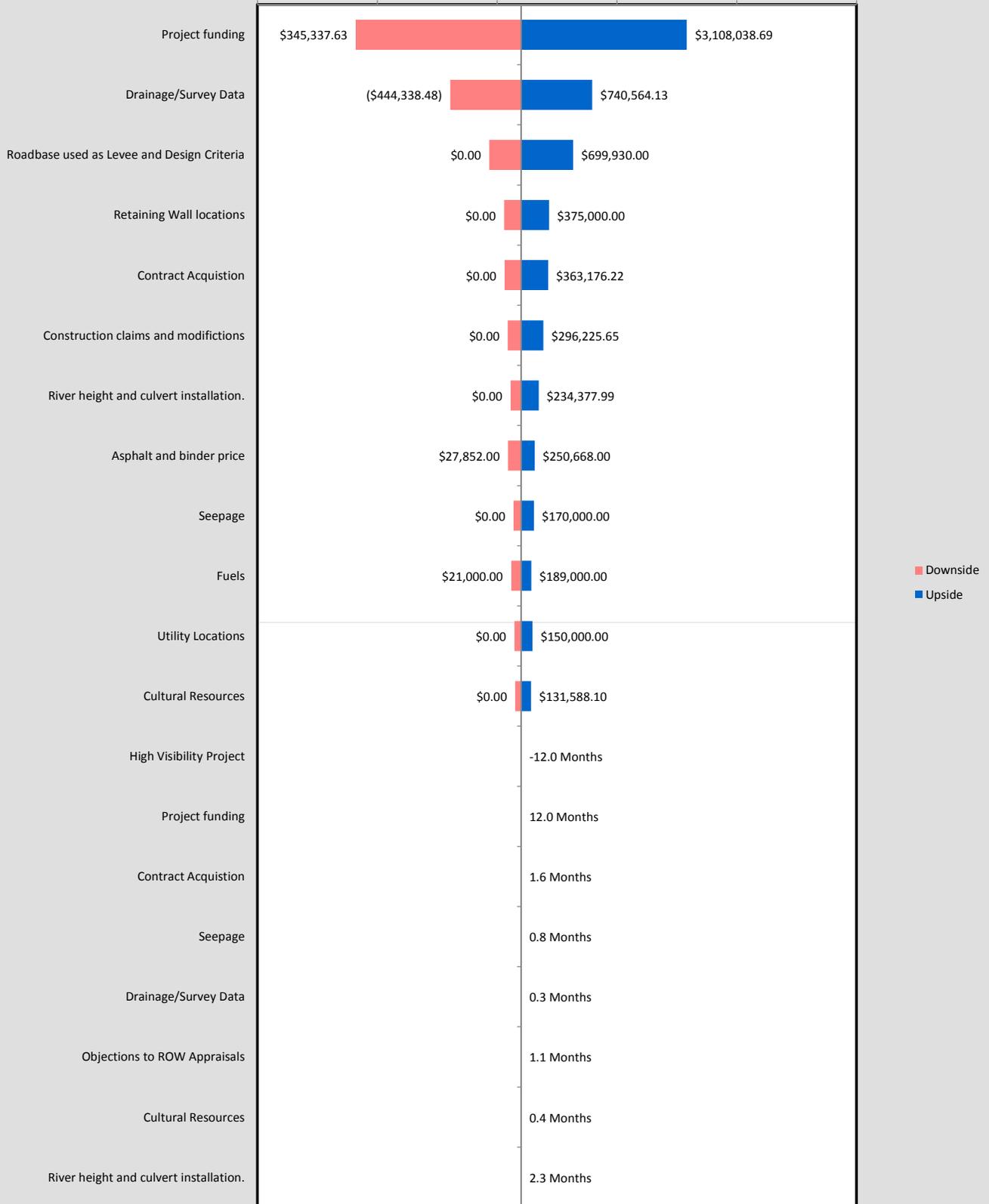
Base Schedule Duration	24.0 Months		
Confidence Level	Duration	Contingency	Contingency %
0%	9.0 Months	-15.0 Months	-63%
5%	22.1 Months	-1.9 Months	-8%
10%	26.2 Months	2.2 Months	9%
15%	27.6 Months	3.6 Months	15%
20%	28.6 Months	4.6 Months	19%
25%	29.8 Months	5.8 Months	24%
30%	30.7 Months	6.7 Months	28%
35%	31.9 Months	7.9 Months	33%
40%	33.1 Months	9.1 Months	38%
45%	34.8 Months	10.8 Months	45%
50%	37.0 Months	13.0 Months	54%
55%	38.4 Months	14.4 Months	60%
60%	39.8 Months	15.8 Months	66%
65%	40.8 Months	16.8 Months	70%
70%	41.8 Months	17.8 Months	74%
75%	43.0 Months	19.0 Months	79%
80%	44.2 Months	20.2 Months	84%
85%	45.6 Months	21.6 Months	90%
90%	47.3 Months	23.3 Months	97%
95%	51.6 Months	27.6 Months	115%
100%	76.6 Months	52.6 Months	219%

Schedule Contingency (Duration) Analysis



Project First Cost Forecast

\$14,000,000 \$15,000,000 \$16,000,000 \$17,000,000 \$18,000,000 \$19,000,000



**PRINCEVILLE FLOOD DAMAGE REDUCTION,
EDGECOMBE COUNTY, NORTH CAROLINA
COST AND SCHEDULE RISK ANALYSIS
(CSRA)**

Prepared by:

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Specific schedule risk derived from team's analysis was based mostly on lack of adequate funding to allow construction under one contract. If construction was not funded for one contract (24 month duration), then construction period could be as much as 44 months. Schedule risks for the construction window were assessed for their impacts to cost and added to the cost contingency for the project.

The following tables show the results for cost and schedule risks with various confidence levels. The 80% confidence level, 35% contingency, has been included in the final recommended plan.

		Risk Level				
		Low	Moderate	High	High	High
Likelihood of Occurrence	Very Likely	Low	Moderate	High	High	High
	Likely	Low	Moderate	High	High	High
	Unlikely	Low	Low	Moderate	Moderate	High
	Very Unlikely	Low	Low	Low	Low	High
		Negligible	Marginal	Significant	Critical	Crisis
		Impact or Consequence of Occurrence				

Project Scope is primarily to raise the roadways around the town of Princeville to serve as a levee in order to provide 100 year level of flood protection. Typical area of raise is approx 5 feet. There are some limited levee construction and tie ins as well as several culverts to provide interior drainage. This is revision 2 to the Risk Register based on a realignment of the eastern segment of the project. This substantially reduced the construction cost estimate and eliminated several miles of road raise as well as significantly reducing the required land acquisitions.

Thresholds

Negligible	\$65,794	1.0 Months
Marginal	\$131,588	2.0 Months
Significant	\$263,176	3.0 Months
Critical	\$394,764	6.0 Months
Crisis	\$657,941	12.0 Months

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost			Project Schedule			Affected Project Component
				Likelihood*	Impact*	Risk Level*	Likelihood*	Impact*	Risk Level*	
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)										
PROJECT & PROGRAM MGMT										
PPM-1	High Visibility Project	Project has high level interest and local sponsor is supportive of project.	Overall due to fiscal risk below this risk is considered as generally neutral in cost and schedule effects. High interest may make project more likely to receive partial funding when all things being equal it may have not received any funding	Likely	Negligible	LOW	Likely	Marginal	MODERATE	Project Cost & Schedule
PPM-2	Project funding	Federal and sponsor funds may be limited due to current economic conditions.	Project is currently schedule as one concurrent project. There are no separable elements as far as benefits of flood risk reduction however there are some logical splits in the construction that could be made to split up project into smaller separable contracts.	Very Likely	Crisis	HIGH	Very Likely	Crisis	HIGH	Project Cost & Schedule

PPM-3	Potential listing of structures on National registry	There are several structures in the proposed area to be protected that are listed as historically significant.	More structures in the proposed area to be protected could help justification and speed project funding.	Unlikely	Marginal	LOW		Unlikely	Marginal	LOW	Project Cost & Schedule
PPM-4	Coordination with DOT	Formal coordination with DOT for design and construction will be required.	Informal coordination with DOT has been conducted. Basic DOT standards already coordinated into design. Time for DOT coordination and plan review was added to schedule.	Very Likely	Negligible	LOW		Very Likely	Negligible	LOW	Project Cost & Schedule
CONTRACT ACQUISITION RISKS											
CA-1	Borrow Source	We have an anticipated borrow area defined for the project, however, it has not yet been determined if this site is feasible. There are numerous other areas in the vicinity that could provide the borrow within similar haul distances.	Real Estate is working to develop the anticipated cost of acquiring borrow area for use of fill. There are multiple potential sources in the local area and it is not foreseen to be a problem obtaining borrow at a reasonable cost.	Likely	Negligible	LOW		Likely	Negligible	LOW	Project Cost & Schedule
CA-2	Contract Acquisition	Project is assumed as one large contract and sequenced accordingly.	Base estimate includes items that are split up as subcontracted. If contract was split into more contracts this would be more expensive and take as much as 12 months longer.	Likely	Marginal	MODERATE		Likely	Crisis	HIGH	Project Cost & Schedule
TECHNICAL RISKS											

TL-1	Floodwall Tie ins	Minor concerns regarding the location of the floodwall and how it ties to the existing project features. 258 floodwall design may need some additional design.	It is anticipated that majority of construction issues will be addressed during the design phase of the project, however, the possibility exists the contractor will need to modify the design to fit unforeseen site conditions.	Likely	Marginal	MODERATE	Likely	Negligible	LOW	Project Cost & Schedule
TL-2	Road base used as Levee	Existing road base and fill is used as levee. Pavement and material/compaction factors need to be finalize.	As design progresses, further discussions with NC DOT are likely and will help establish the pavement criteria at that time. it is likely that even if we decided on a pavement section now - it is likely to change by the time plans and specifications are in place. PDT has done their best to estimate what will be required based on similar projects in the	Likely	Crisis	HIGH	Likely	Negligible	LOW	Project Cost & Schedule
TL-4	Seepage	Some areas may need some additional measure(segment3) to alleviate seepage.	Some investigations will be required .But there are no known issues known with embankment.	Unlikely	Marginal	LOW	Unlikely	Marginal	LOW	Project Cost & Schedule
TL-5	Section 3Levee	Roadway dips in some areas along three and will require a levee	New levee construction required I section 3 vice doing" interstate highway improvement. Interstate 64 will be underwater now during a flood event. NCDOT may want Levee on West side of 64 vice East side. Cost would increase exponentially if it had to go on the west side.	Unlikely	Crisis	HIGH	Unlikely	Significant	MODERATE	Project Cost & Schedule
TL-6	Nothing in plan will "reduce protection"	Any work on road in 4 will be an improvement as it is currently below grade	Scheduling just needs to be watched so that say you don't put the flapper valves on in segment 4 until the excavation done in internal drainage area. Segment 1 can be done anytime.	Likely	Negligible	LOW	Very Likely	Marginal	MODERATE	Project Cost & Schedule

TL-7	Drainage/Survey Data	Scope of work is defined for exterior drainage structures, however - where that line exists between exterior and interior drainage features/runoff, discharges, etc. is undefined until accurate survey can be completed. Quantities made from LIDAR topographic data	Detailed survey should be completed during the plans and specifications stage of design. There is the potential that additional drainage measures may be discovered upon analysis of the survey. It is likely that additional design work will be necessary. Quantities are accurate to about +/- 6 inches. There is some raw data in lidar contract provisions. But the impression is that generally they should be accurate.	Likely	Crisis	HIGH	Likely	Significant	HIGH	Project Cost & Schedule
LANDS AND DAMAGES RISKS										
LD-1	Retaining Walls	Concern is that more real estate may be required to obtain 'desirable' retaining wall alignment.	Stakeholders and Local sponsors (NC DOT) may generate concerns with regard to location of the retaining wall and this will require minor adjustments to be made to the alignment.	Unlikely	Critical	MODERATE	Unlikely	Negligible	LOW	Project Cost & Schedule
LD-2	Utility Locations	There may be unknown utility crossings in some areas	There has been good coordination with DOT and utility crossings as the majority of the roads currently serve as levees. Known utilities appear to be installed to USACE standards. Existing roadway already part of levee system- district has good account of what has gone through roadway. preliminary thought is low risk. Segment 2 and Segment 3 we may have some unknown crossings.	Unlikely	Marginal	LOW	Unlikely	Negligible	LOW	Project Cost & Schedule
LD-3	Land Acquisition	Limited acquisitions of properties are required for selected alternative.	Majority of project is in NCDOT Right of Way. Some right of way will need to be obtained across a farmers field along what appears to be an existing irrigation ditch	Unlikely	Negligible	LOW	Unlikely	Negligible	LOW	Project Cost & Schedule

			Right of way admin costs needs to be included in RE costs as basic construction costs for temporary accessory acquisition etc.								
LD-4	Temporary access roads	Temporary access roads in estimate approx 16' wide included.		Very Likely	Negligible	LOW		Very Likely	Negligible	LOW	Project Cost & Schedule
LD-5	RR crossing	One RR crossing is in the selected alternative. It is already at design height	May need repair work. Scope not included in recommended plan as it is an O&M cost.	Unlikely	Negligible	LOW		Very Likely	Negligible	LOW	Project Cost & Schedule
LD-6	Repairs on Driveways	Higher roadways will require raise of many driveways	Revised alignment minimized driveways affected.	Very Likely	Negligible	LOW		Very Likely	Negligible	LOW	Project Cost & Schedule
LD-8	Age of Appraisal	Age of real estate estimate	Appraisals are old and values need to be updated from 2007 but real estate prices down or leveled off 25% AND MOSTLY BASED ON LAND COSTS.	Likely	Marginal	MODERATE		Likely	Marginal	MODERATE	
LD-9	Objections to ROW Appraisals	Landowners may object to ROW appraisals	HIGHLY LIKELY THERE ARE OBJECTIONS TO FAIR MARKET VALUE but GENERALLY AGREE TO APPRAISALS after shown methodology. Not anticipated to be a large cost	Very Likely	Negligible	LOW		Very Likely	Significant	HIGH	

LD-10	Relocations	Pipeline crossing	One pipeline to be relocated but if more different location and land acquisition --headwall not relocated If the pipe size is changed there could be additional costs. None expected ... all is within NCDOT relocation	Unlikely	Negligible	LOW		Unlikely	Negligible	LOW	
LD-11	Revised alignment skirts irrigation ditch.	Revised project alignment in NE corner of protected area skirts a farmers field that appears to have remnant irrigation ditches.	Estimate has culvert and reconstruction included, Aerial photos of the area may indicate that the water table is close to the surface in this area and the levee construction may need some additional stabilization. Based on three projected final height this is most likely a small cost.	Likely	Negligible	LOW		Likely	Negligible	LOW	
REGULATORY AND ENVIRONMENTAL RISKS											
RE-1	Proximity to wetlands and river ecosystem	No Wetlands of significance or Tar River standoff implications in recommend plan.	Area involved in project does not appear to be above thresholds that would cause additional administrative action. If it does require additional action it would delay the project	Unlikely	Marginal	LOW		Unlikely	Significant	MODERATE	Project Cost & Schedule
RE-2	Endangered Species	Certain land parcels , access and egress might be compromised if certain endangered species are found or migrate thru the project boundaries. Plan "B" parcels may be needed. However this is currently not anticipated to be an impact	Due to proximity of existing roadway over the majority of the area it is not anticipated that any endangered/protected species will be encountered.	Very Unlikely	Marginal	LOW		Very Unlikely	Significant	LOW	Project Cost & Schedule
CONSTRUCTION RISKS											

CON-1	Traffic flow during construction	Limited access in segment 4 and 5.	Segment 4 and Segment 5 may cause issues. Currently Jersey barriers only in estimate. Additional costs may need to be added for staging inefficiencies, flagging, pilot cars etc.	Very Likely	Marginal	MODERATE	Very Unlikely	Negligible	LOW	Project Cost & Schedule
CON-2	Cultural Resources	Cultural studies may be incomplete. There may be potential for encountering unknown cultural resources that could impact project access, staging and project boundaries.	Majority of project is in existing floodplain that has been disturbed previously by road construction. It is not thought to be a significant likelihood of encountering cultural resources.	Unlikely	Marginal	LOW	Very Unlikely	Negligible	LOW	Project Cost & Schedule
CON-3	Long lead items	Lead time on gates for 7x6 box culverts	Generally most materials are readily available with the backflow gates for box culverts. (22 weeks)	Very Likely	Negligible	LOW	Very Unlikely	Negligible	LOW	Project Cost & Schedule
CON-4	River height and culvert installation.	Box culverts may need some temporary dewatering/sheet pile, especially in rainy season.	33 culverts- many are located high in relation to river. Box Culvert has flow through and tail water from river can back up to structure.(culvert 2 area 1)	Unlikely	Crisis	HIGH	Unlikely	Critical	MODERATE	Project Cost & Schedule
CON-5	Staging areas	No defined staging areas beyond right of way Not	Not anticipated to be an issue. There are large areas near the 33 interchange in the right of way that can be used for staging	Very Likely	Negligible	LOW	Very Unlikely	Negligible	LOW	Project Cost & Schedule

CON-6	Construction claims and modifications	Work is generally typical of highway construction	There is always some risk of modifications and claims.	Very Likely	Crisis	HIGH	Very Unlikely	Negligible	LOW	Project Cost & Schedule
ESTIMATE AND SCHEDULE										
EST-1	Retaining Wall locations	Retaining wall will be required along some areas of roadway raise	Locations of retaining wall and respective heights have been based on the latest publicly available topographic data, not detailed survey of the project. Therefore, the overall square footage and type of retaining wall may change after such survey and geotechnical analysis are complete - presumably during plans and specifications phase of design.	Very Likely	Significant	HIGH	Very Likely	Negligible	LOW	Project Cost & Schedule
EST-2	Construction Access	Temporary access off of 258 could impact construction contractor	Rom plan may not be adequate to provide access and maintain efficiency. Traffic control will need to be added. 85% productivity applied. Local traffic only will be allowed on certain segments. Restatement of LD4	Very Likely	Negligible	LOW	Very Likely	Negligible	LOW	Project Cost & Schedule
EST-3	Fuels	Large portion of work is in earthwork. The price of fuel could adversely impact the construction costs	Variations in fuel cost is generally a factor in large earthwork jobs	Very Likely	Critical	HIGH	Very Likely	Negligible	LOW	Project Cost & Schedule

EST-4	Asphalt and binder price	There is a significant portion of the project cost in repaving the raised roadbeds after the raise.	The future price of asphalt should be studied to adequately cover normal price increases as well as anticipated thickness etc.	Very Likely	Critical	HIGH	Very Likely	Negligible	LOW	Project Cost & Schedule
Real Estate Risks										
RE-1	Age of Appraisal	Age of real estate estimate	Appraisals are old and values need to be updated from 2007 but real estate prices down or leveled off 25% AND MOSTLY BASED ON LAND COSTS.	Likely	Marginal	MODERATE	Likely	Marginal	MODERATE	Project Cost & Schedule
RE-2	Objections to ROW Appraisals	Landowners may object to ROW appraisals	HIGHLY LIKELY THERE ARE OBJECTIONS TO FAIR MARKET VALUE but GENERALLY AGREE TO APPRAISALS after shown methodology. Not anticipated to be a large cost	Very Likely	Negligible	LOW	Very Likely	Significant	HIGH	Project Cost & Schedule
Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)										
PR-1	Hurricane or another 100year plus event	Another significant flood event could change the inhabitants perspective or political climate supporting the project.	Beyond the scope of the team to model or effect.	Unlikely	Crisis	HIGH	Unlikely	Crisis	HIGH	Project Cost & Schedule

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely, Unlikely, Moderately Likely, Likely, Very Likely**. The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible, Marginal, Significant, Critical, or Crisis**. Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low, Moderate, or High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. A risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.

7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.