Mississippi Valley Division,
Regional Planning and Environment Division South

South Central Coast Louisiana

Feasibility Study with Integrated Environmental Impact Statement

Hurricane Ike flooding in Delcambre, Louisiana 2008.

Appendix B - Engineering Appendix

June 2021

Controlled by: USACE MVD
CUI Category(ies): USACE MVN
LDC or Distribution Statement: FEDCON
POC: Karla Sparks, [redacted]

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Section 1
Purpose

This engineering report summarizes the engineering and design work completed to support the components of the South Central Coastal Louisiana (SCCL) Study. This report includes engineering analyses, including levee design and hydrologic control structure designs.

1.1 INTRODUCTION

The study area, which is shown in Figure B:1-1, includes three parishes along the Louisiana coast beginning near Morgan City, Louisiana and extending west to Delcambre, Louisiana. The coastal parishes are adjacent to the Gulf of Mexico and extend inland or north approximately 90 miles near Arnaudville, Louisiana. The area consists of St. Martin Parish, Iberia Parish, St. Mary Parish and the coastal boundary of the latter two parishes. Figure B:1-2 shows the locations of the parishes within the study area.

The eastern study boundary includes the western portion of the Atchafalaya Basin, beginning on the north near Arnaudville, Louisiana, and extending south to Morgan City, Louisiana. The Atchafalaya Basin is the largest wetland and swamp in the United States. It includes the Lower Atchafalaya River, Wax Lake Outlet, Atchafalaya Bay, the Atchafalaya River, and Bayous Chêne, Boeuf, and Black navigation channel. During the early 20th century, the Atchafalaya River Basin was designated as a spillway for floods of the Mississippi River. Numerous large access canals and pipeline canals were dredged through deep swamp areas, across bayous, and across the Atchafalaya River. The Atchafalaya Basin is bordered on the west by the West Atchafalaya Basin Protection Levee (WABPL), which separates the Atchafalaya Basin from primarily agricultural lands in the western part of the study area, and to the east by the East Atchafalaya Basin Protection Levee (EABPL), the eastern boundary of the Atchafalaya Floodway.

The western part of the study area is dominated by Bayou Teche, a former main channel of the Mississippi River, and is primarily agricultural. Agriculture land use dominates the natural terraces adjacent to Bayou Teche that have developed from thousands of years of flood events. These natural terraces are characterized by fine grained soil deposits such as clays and silts, but can include some sands. They are traditionally rich in nutrients and are well suited for agriculture. Bayou Teche is bordered in the south by U.S. Hwy 90 and by the north and west study boundaries.

South of U.S. Hwy 90, the study area is characterized by coastal plains and marshes and influenced by tides and brackish waters. This area has significant oil and gas development and infrastructure. Salt domes and associated extraction industries are major occurrences along the Gulf of Mexico coast. Avery Island, Weeks Island, and Cote Blanche Island are domes located within the study area. The coastal plain area on the eastern study area boundary includes both the Atchafalaya River bay, where the Atchafalaya River meets the Gulf of Mexico, and the Wax Lake Outlet. Both the Atchafalaya River and the Wax Lake

Outlet are outlets for the Atchafalaya Basin. It should be noted that due to the high sediment load, the Wax Lake Outlet and Atchafalaya River delta area are the only developing deltas along the Louisiana coast. Approaching from the east and south of U.S. Hwy 90, the Gulf Intracoastal Waterway (GIWW) intersects the study area just north of Avoca Island, near Morgan City, Louisiana. The GIWW continues west toward Texas; however, the western boundary of Iberia Parish serves as the boundary of the study area.

1.2 STUDY PURPOSE

The purpose of this study is to provide hurricane and storm damage risk reduction to reduce the risk of flood damages caused by hurricane and storm surges.

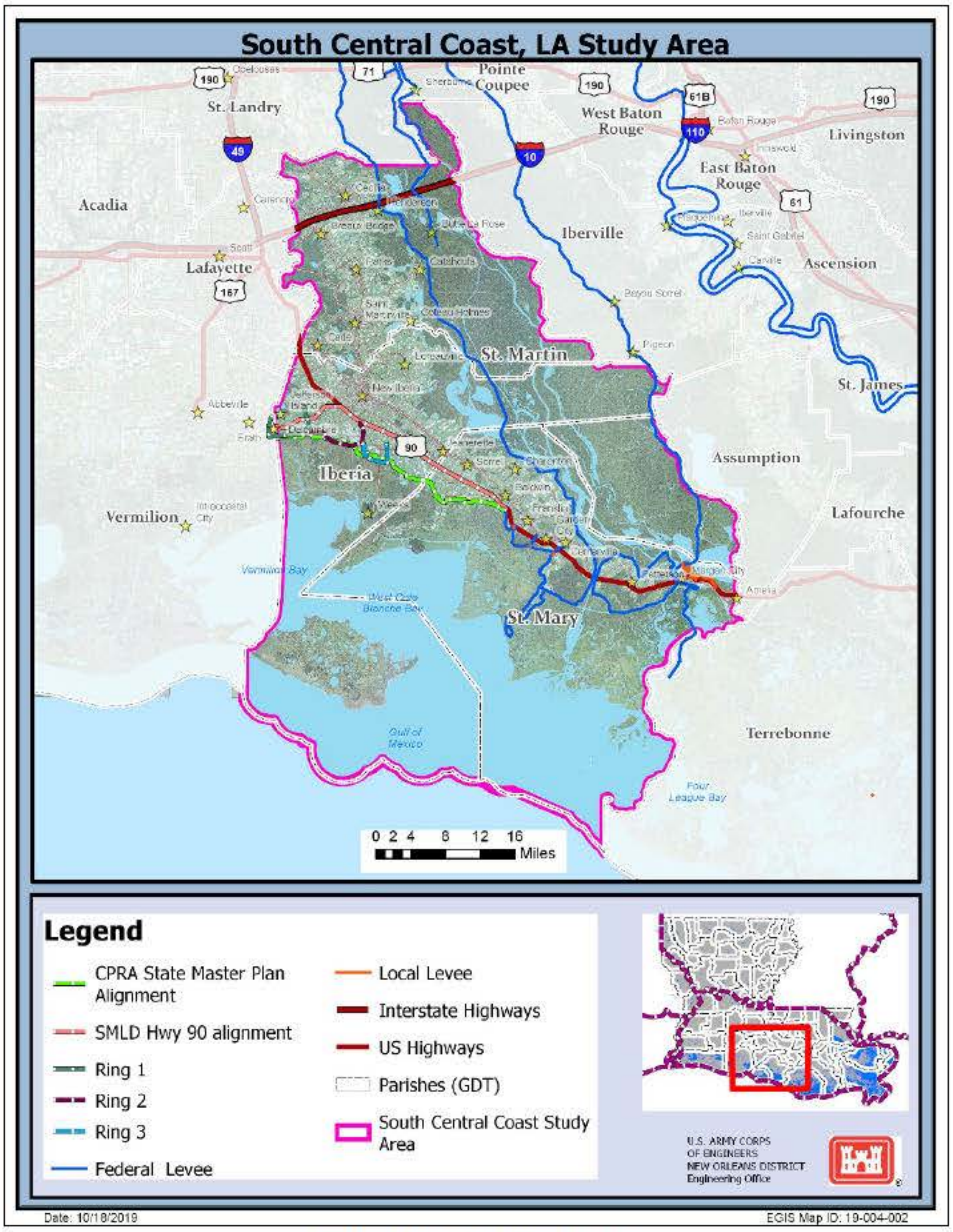

Figure B:1-1. Study Area

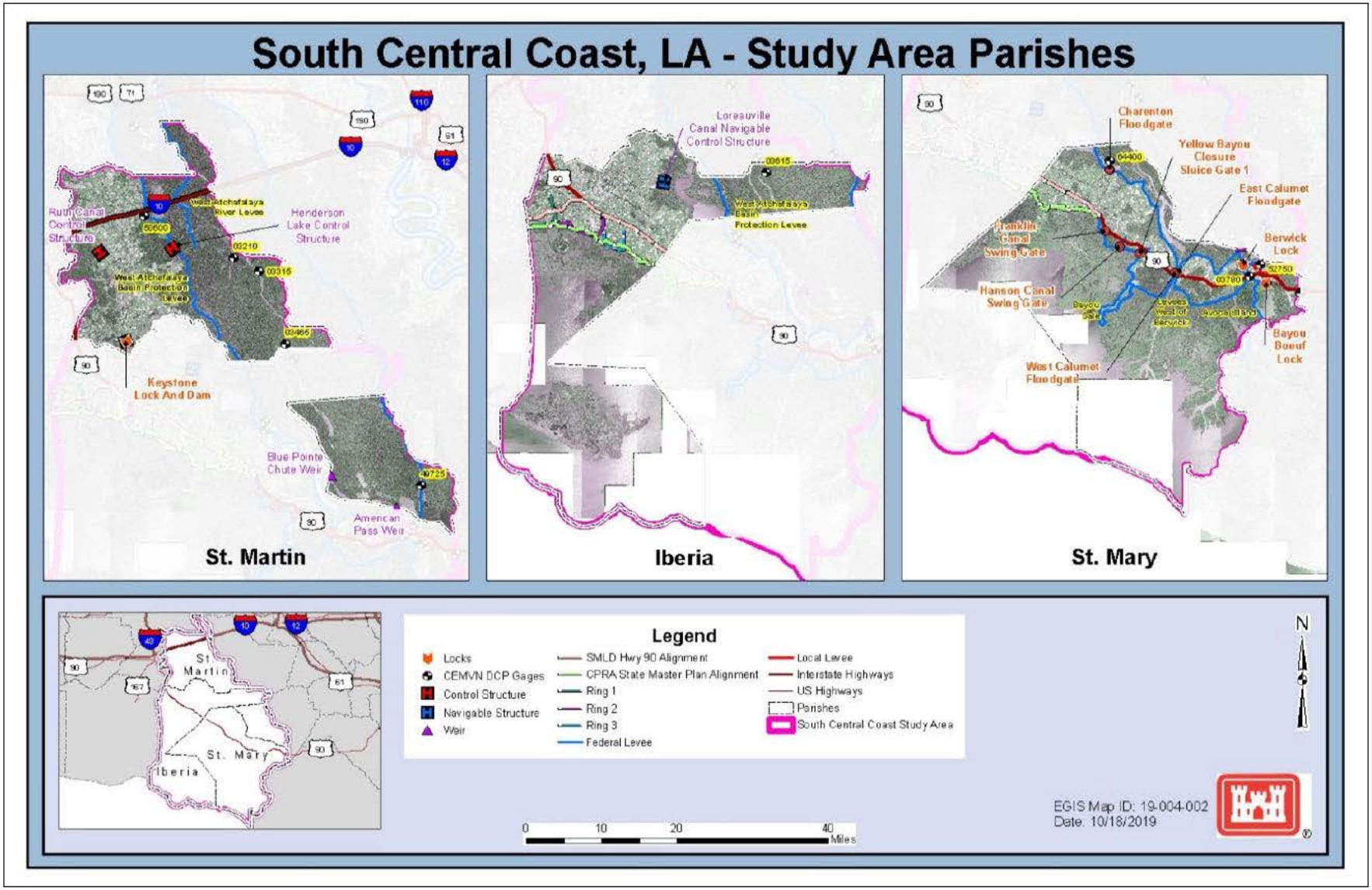

Figure B:1-2. Study Area Parishes

1.3 STUDY OVERVIEW

Hurricane and storm damage risk reduction measures were developed and screened using parametric costs and benefits to identify a focused array of measures. Measures carried through to the focused array are discussed in Section 1.4.

1.4 MEASURES

The U.S Army Corps of Engineers (USACE) analyzed structural and nonstructural measures. Descriptions of measures and screening methodology are discussed in Section 3 of the Main Report. Measures carried through the third iteration include:

Measure 1- Construct Comprehensive Levee System A with associated pumps and gates.
Measure 5- Raise existing Morgan City Back levees (all segments).
Measure 6- Raise existing Levees West of Berwick (all segments).
Measure 7- Construction of new Ring Levee alignment 1 with associated pumps and gates.
Measure 8- Construction of new Ring Levee alignment 2 with associated pumps and gates.
Measure 9- Construction of new Ring Levee alignment 3 with associated pumps and gates.
Measure 11 var. a- Elevate and floodproofing structures within the 25 year storm surge floodplain.
Measure 11 var. b- Elevate and floodproofing structures within the 50 year storm surge floodplain.
Measure 11 var. c- Elevate and floodproofing structures within the 100 year storm surge floodplain.
Measure 16- Acquisition and relocation of structures within the 25 year Floodplain.

Each structural levee measure were evaluated at the 0.01 Annual Exceedance Probability (AEP) level of risk reduction.

In a coastal environment, flood risk can be caused by a combination of hurricane surge, waves, wave overtopping of structures, rainfall flooding (including riverine flooding due to rainfall), or other sources. In the SCCL project area, a majority of the damages for the 0 to 10-year events are caused by rainfall events and for the 50 to 100-year events, economic damages are associated with storm surge events.

Storm surge and wave design considerations were the primary drivers for project measures. Risk in the case of the levee designs is defined as the probability that an area will be flooded by storm surge, resulting in undesirable consequences. Engineering Manual (EM) 1110-2-1913 was used a guide to develop design cross sections for new levees. Performance criteria considerations were informed by Engineering Regulation (ER) 1105-2-101. USACE policies require project performance to be described in terms of annual chance or exceedance probability and long-term risk rather than level of protection. In terms of annual

chance or exceedance probability, a 0.01 AEP levee is designed to withstand a storm surge that has a 1 in 100 chance of occurring in any given year.

The Levee Safety Action Classification (LSAC) is a system designed to take into account the probability of the levees being loaded (Hazard), existing condition of the levee, the current and future maintenance of the levee (Performance), and the Consequences if a levee were to fail or be overwhelmed. All existing levees and structures within the study area have an LSAC classification of 2, as of the latest inspections and ratings.

Designs and costs were developed for each level of risk reduction for each measure. The levee alignments referred to above are shown in Figures B:1-3 through B:1-6. Further details on these alignments and how they were developed are provided in the Main Report. Details of the analysis and selection of the nonstructural alternative can be found in Appendix D: Economics.

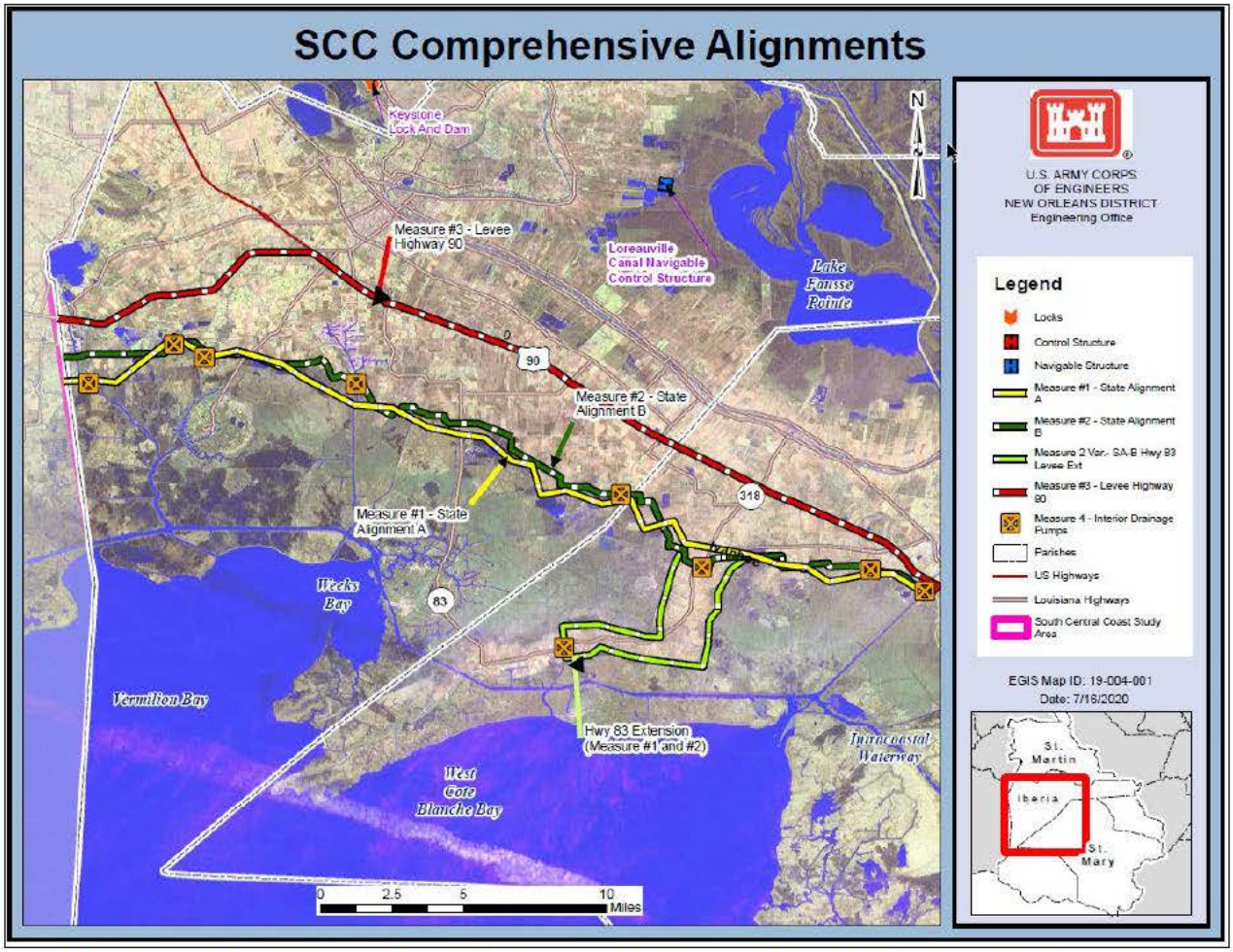

Figure B:1-3. Measure 1 Comprehensive Levee Alignment Measure (yellow alignment)

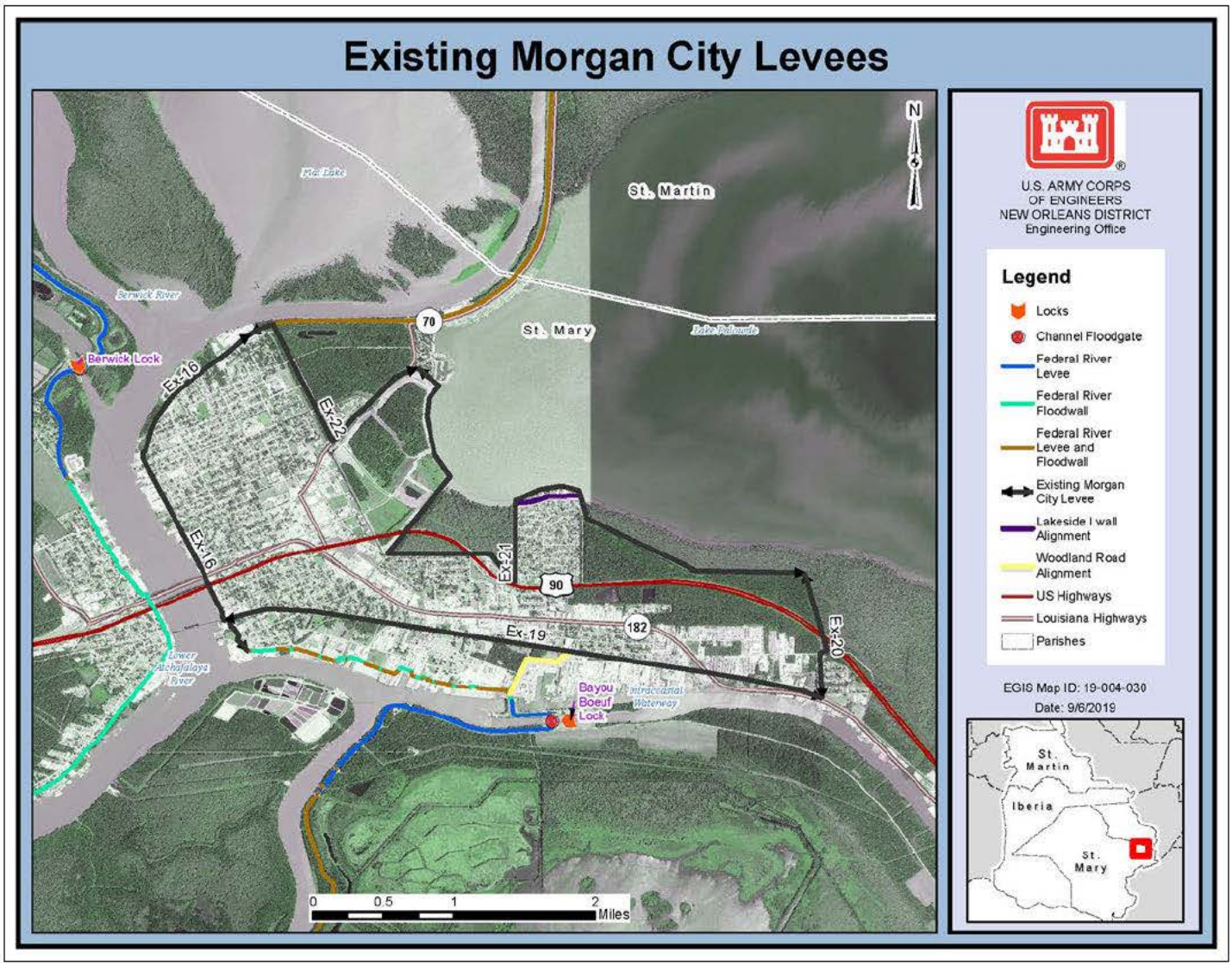

Figure B:1-4. Measure 5- Morgan City, Raise Existing Levees

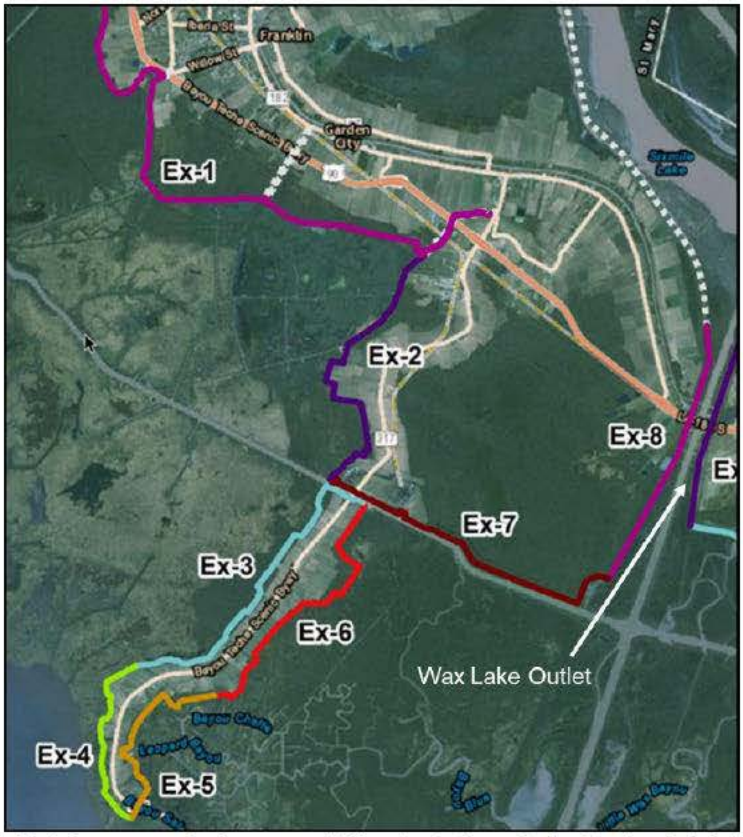

Figure B:1-5. Measure 6- Levees West of Berwick, Raise Existing Levees

Figure B:1-6. Ring Levee Alignments 1, 2, and 3 (Measures 7, 8, and 9)

Section 2
Surveys

No new surveys were completed for the analysis of the final array of measures. Existing statewide data was used for measure development and evaluation. Site-specific surveys for the detailed design on measures included in the recommended plan will be completed in implementation documents during Planning Engineering and Design (PED). Future surveys will be performed in accordance with the USACE New Orleans District's (CEMVN) Minimum Survey Standards and the CEMVN Datum Coordinator will approve the respective survey plans

Section 3
Geotechnical

This section summarizes the preliminary geotechnical design results for the SCCL Study. The results presented in this section are only intended for cost estimating purposes and determining the technical feasibility of the proposed measures. A full range of geotechnical analyses will be performed, if any of the proposed measures are selected for construction. Figures B:3-1 through B:3-4 show the general location of the measures discussed in this section:

- **Measure 5:** Raising existing sub-segments of Levees West of Berwick
- **Measure 6:** Raising existing sub-segment of existing Morgan City Back Levees
- **Measure 7:** Ring Levee 1, starting east of the City of Delcambre, Louisiana
- **Measure 8:** Ring Levee 2, starting near New Iberia and ending near Lydia, Louisiana
- **Measure 8 var.:** Ring Levee 1+2, starting near Delcambre, Louisiana and ending near Lydia, Louisiana
- **Measure 9:** Ring Levee 3, beginning east of Port of Iberia along Weeks Island Road and encompassing the town of Lydia and extending toward City of New Iberia, Louisiana

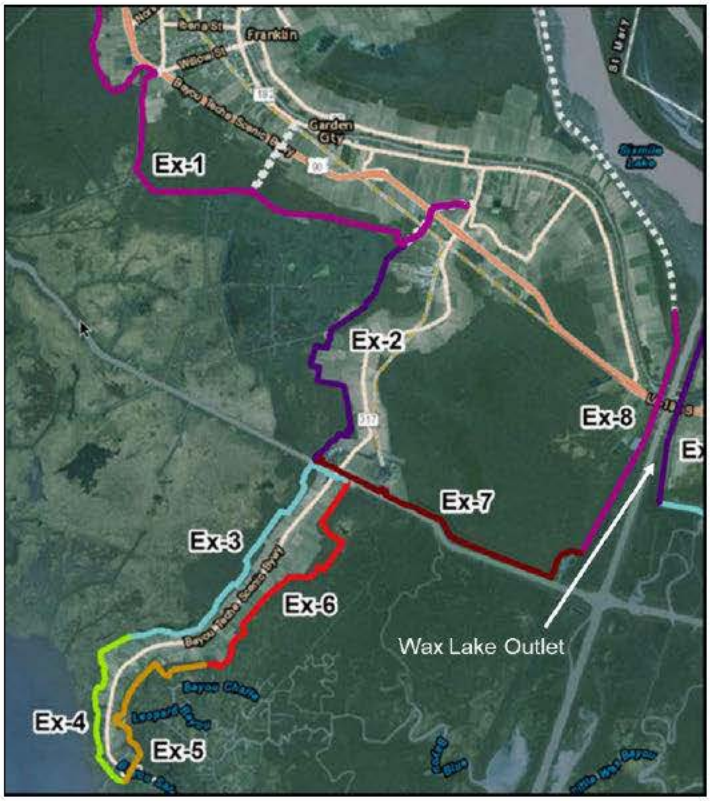

Figure B:3-1. Measure 5 Existing Levees West of Berwick with Sub Segment Identified

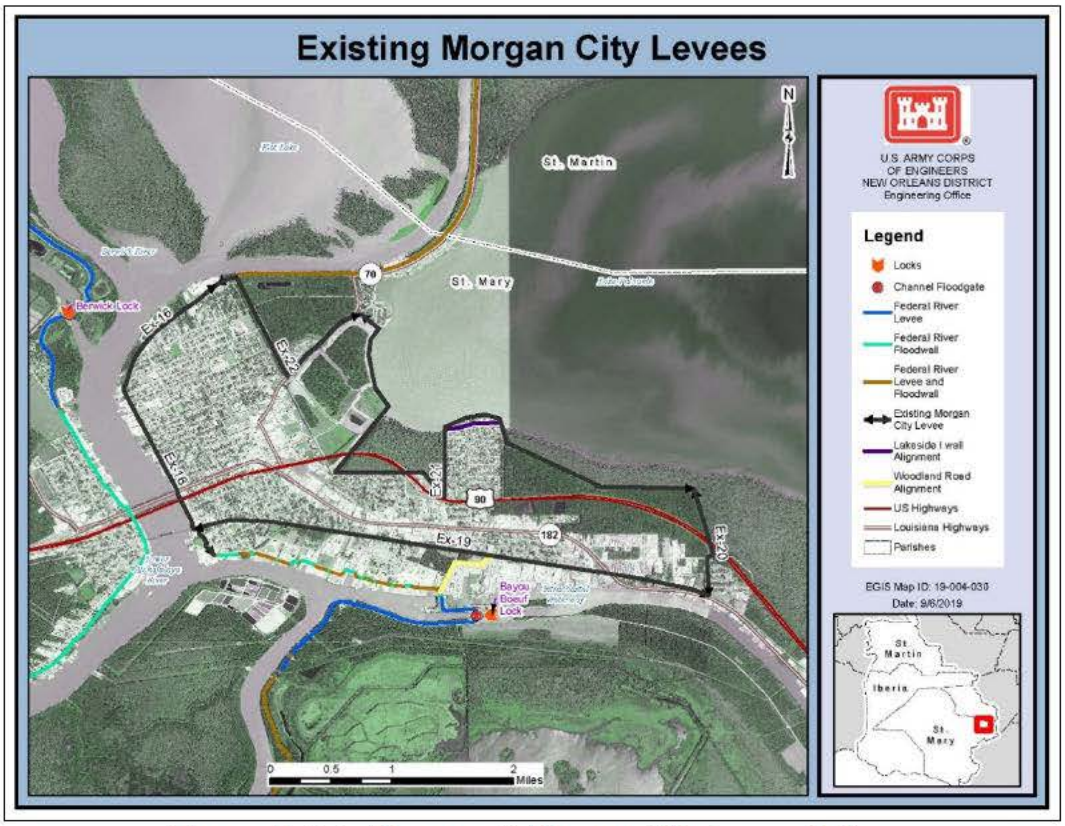

Figure B:3-2. Measure 6 Morgan City Levee Raises

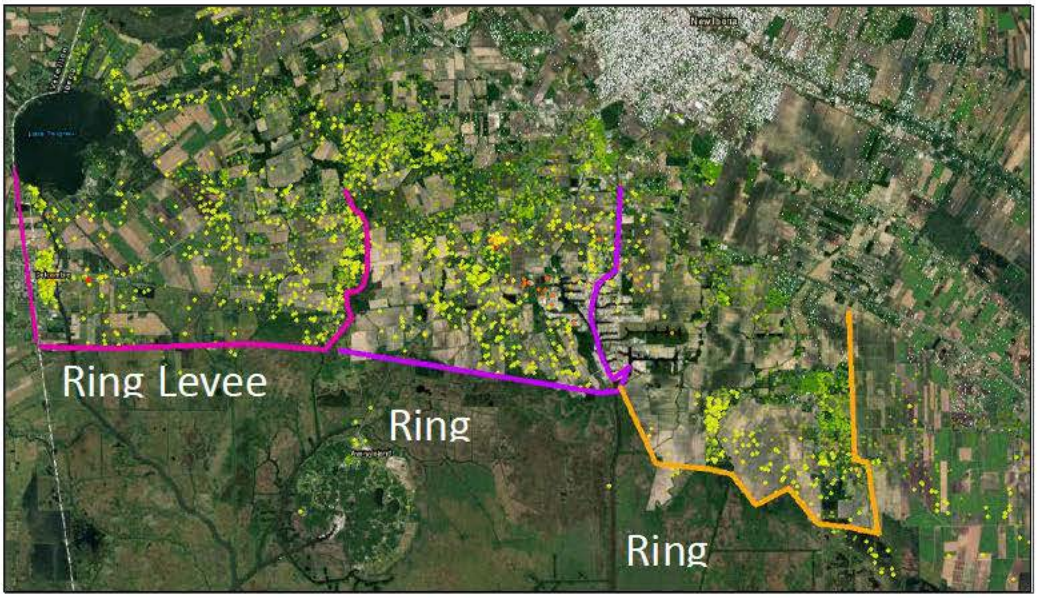

Figure B:3-3. Measures 8 and 9 Ring Levees 1, 2, and 3

Figure B:3-4. Measure 8 var. Combined Ring Levees Conceptual Alignment 1 +2

3.1 GEOLOGY

The SCCL study area is composed of Pleistocene Prairie Terraces and several types of Holocene deposits including: a northeast section of majority back swamp deposits, a central area of riverine deposits, and a southwest section of deltaic deposits.

The northeast section is primarily composed of back swamp deposits. These back swamp deposits consist of clay with thin peat layers and plant/wood material. Back swamp deposits in this area typically reach depths of 120-140 feet below the surface. At the southern end of the northeast section, the Atchafalaya River and adjacent lakes produce surficial deposits of fat and lean clays with sandy silt of natural levees (0-5 feet above sea-level) overlying lacustrine clay (0-15 feet below sea-level). These deposits overlie back swamp deposits that extend 15-130 feet below sea-level (Dunbar, 1994).

In the central section of the study area, a former channel of the Mississippi River, which fed the then-active Teche delta, created a stratigraphy of inter-fingering layers of fat and lean clays and sandy silt of natural levees (5-15 feet above sea level). From 5 feet above sea-level to 60 feet below sea-level, the stratigraphy is made up of back swamp organic clays and point bar sand. Distributary sand can also be found at this depth or up to 120 feet below sea-level. Then, from 60-200 feet below sea-level, substratum sand deposits dominate (Dunbar, 1994).

Deltaic deposits in the southwest section consist of Mississippi deltaic deposits (Teche delta lobe) and Atchafalaya deltaic deposits. These deposits are predominantly composed of a cyclic pattern of inter-distributary organics and clay, distributary sand, natural levee clay and silt, delta-front silt, and prodelta clay. These deposits overlie the Maringouin delta lobe of similar pattern and the Pleistocene Prairie Terrance. The Pleistocene Prairie Terrace consists of low, flat plains that slope gently towards the Gulf of Mexico (Mange and Otvos, 2005). These deposits are made up of green-grey clay with sand and silt layers, extending hundreds of feet into the subsurface.

3.2 GEOTECHNICAL DESIGN

This section discusses the design assumptions used for analyzing each measure.

Soil borings were not taken and soil testing was not performed for this study. Soil unit weights and shear strengths were assigned based on USACE geotechnical experience in the region and limited boring information. The design sections were developed using these EMs and Engineering Circulars (EC):

- EM 1110-2-1913: Design and Construction of Levees (April 2000)
- EM 1110-2-1902: Slope Stability (October 2003)
- EM 1110-1-1904: Settlement Analysis (September 1990)
- EC 1110-2-6066: Design of I-Walls (April 2000)

The Hurricane and Storm Damage Risk Reduction System (HSDRRS) design criteria was also used as a reference, but was not used for establishing design criteria for measures included in the final array.

It was assumed that the levee elevations would need to remain above the 0.01 (100 year storm surge) AEP (Annual Exceedance Probability) levee elevation for the project design life. It was also assumed new borrow pits adjacent to the levee alignments would not be feasible due to previous utilization of adjacent borrow pits in the case of existing levees and the existing adjacent development and infrastructure in the case of new levees. Seepage analyses were not performed for parametric design and evaluations. All elevations discussed in the following sections are North American Vertical Datum of 1988 (NAVD 88) unless noted otherwise.

Based on historic levee performance in the vicinity of the study area, levee slopes steeper than 1V:4H have been known to have issues with slope instability, with slides occurring regularly in those cases. Due to the historical issues with side slopes greater than 1V:4H, any staged construction assumptions were eliminated since steepening slopes is the primary advantage of staged construction. The PDT was conservative, in terms of not overestimating the levee footprint, when utilizing 1V:4H. Further evaluation of structural measures would have likely resulted in a modification to levee side slopes to 1V:6H and associated footprint expansion.

3.2.1 Measures 7, 8, and 9 – Ring Levees 1, 1+2, 2, and 3

Measures 7, 8, and 9 – Design Assumptions

Ring Levees 1, 2, and 3 would be located between Erath, Louisiana (to the west) and Lydia, Louisiana (to the east). Ring Levees 1, 2, and 3 were originally known as Ring Levees A, B, and C, respectively, at the initiation of the study. Profiles for the 0.01 AEP levee elevation were provided for geotechnical review. Table B:3-1 summarizes the design assumptions related to the 0.01 AEP levee elevations for the Ring Levees.

Table B:3-1. Summary of 0.01 AEP Ring Levee Elevations.[A]

Ring Levee	Minimum Current 1% AEP Elevation (ft)	Maximum Current 1% AEP Elevation (ft)	Current Representative 1% AEP Elevation [B] (ft)	50-year Representative 1% AEP Elevation [B] (ft)
1	15.5	19.4	17.6	21.6
2	12.0	17.5	15.5	
3	14.5	15.0	14.8	

[A] All elevations are in NAVD88 (ft.). Minimum and maximum elevations taken from USACE (2019) Plan & Profiles for the 0.01 and 0.02 AEP Elevations for Ring Levees 1, 2, and 3.

[B] Representative elevations are based on weighted averages of the 0.01 AEP elevations along the length of the alignments.

A review of existing boring information along the proposed levee alignments was performed. Strength testing data was only found for one boring within 2,000 feet of the proposed alignments. This data was used to perform basic slope stability analyses. Recent LIDAR data was not available, but the available data showed existing ground elevations between 0 and 10 feet.

Consolidation testing data was not available for any of the reviewed borings. However, the geotechnical appendix from the following report contained settlement analyses that were recently performed for a different nearby alternative being considered for the South Central Coast Study: ARCADIS, U.S., Inc. 2017. *South Central Coast Louisiana Flood Protection Study. Appendix M – Geotechnical Report*. Prepared for the Coastal Protection and Restoration Authority.

The alignment for this nearby alternative is shown in Figure B:3-5. The alignment is in close proximity to the Ring Levee measure and is oriented roughly parallel to the Gulf of Mexico side of the proposed ring levees.

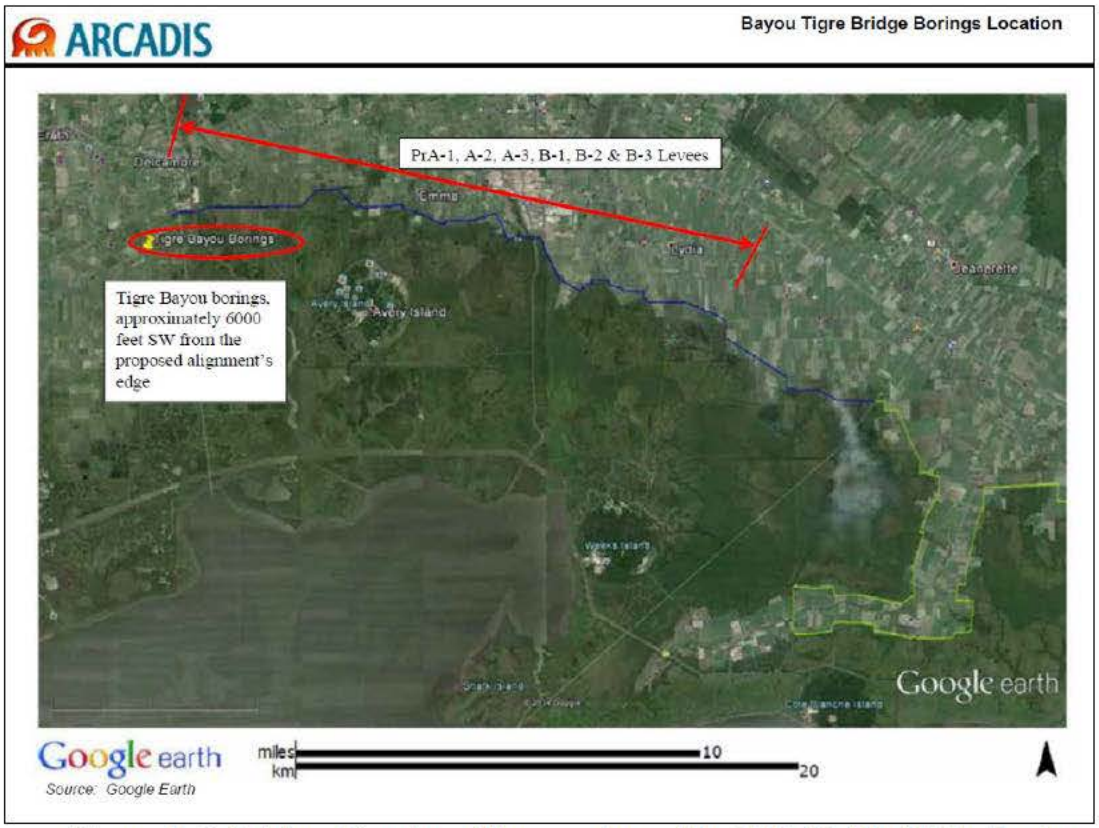

Figure B:3-5. Map Showing Alignment used in CPRAB (2019) to Analyze Settlement

It should be noted that due to lack of data, the Coastal Protection and Restoration Authority Board (CPRAB) (2017) settlement analyses were based on testing data from borings taken on the western end of the proposed alignments for a different project. The analyses were reviewed and considered to have been completed using reasonable cost estimating purposes. The proposed lift schedule from the CPRAB (2017) report is shown in Figure B:3-6.

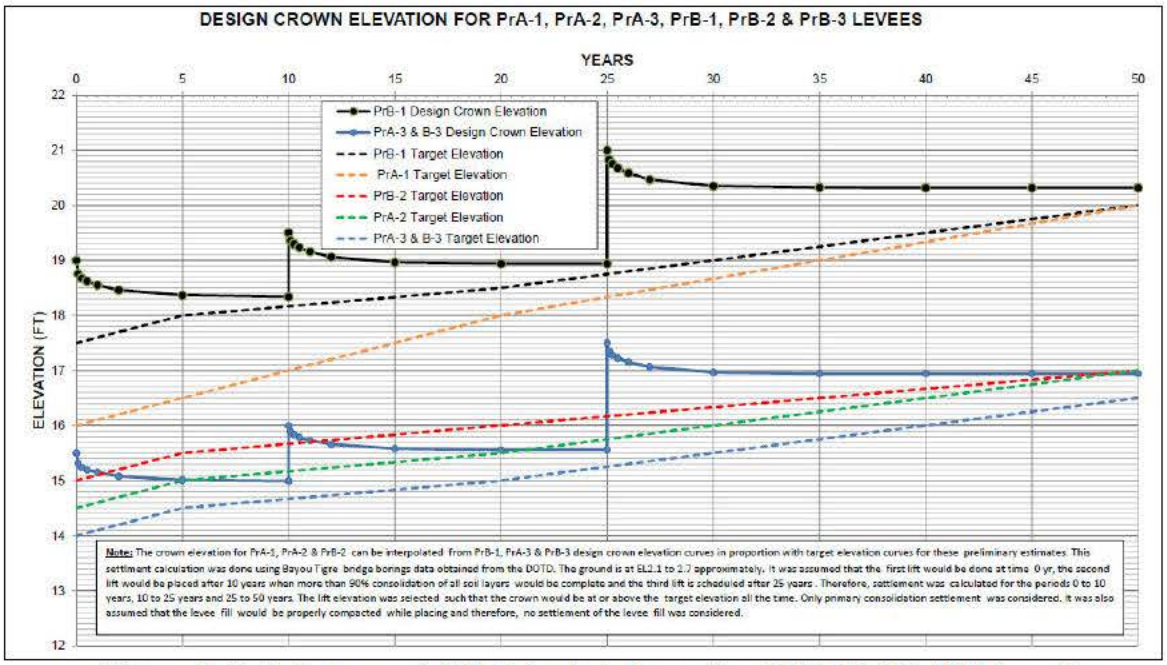

Figure B:3-6. Proposed Lift Schedule from the CPRAB (2017) Report

3.2.2 Measures 7, 8, and 9 – Design Development

Using the available information and design assumptions, a typical design section was developed to analyze settlement and slope stability. The methodology used to develop the typical design section considered the following:

Selection of the initial construction grade elevation should be conservative since this would result in higher total settlement values and reduce cost estimating risk. As a result, the current 0.01 AEP representative levee elevation for Ring 3 was selected for the typical design section. This value is shown as 17.6 on Table B:3-1.

Based on the CPRAB (2017) report and USACE experience in the area, 1 to 2 feet of settlement is anticipated within 10 years of initial construction. As a result, 2 feet of overbuild was added to the typical section, which raised the initial construction grade elevation to 19.6.

Due to lack of high quality consolidation and survey data, there is significant uncertainty in the estimated settlement that will occur for individual segments of the ring levees. As a result, a representative 0.01 AEP levee elevation was selected for a target elevation in order to develop a lift schedule for the typical levee section. Based on the available 50-year predictions, a representative target elevation of 21.6 feet was selected. This is a weighted average of the 50-year predictions for all segments of the ring levees.

Based on the design assumptions and settlement analyses performed in the CPRAB (2017) report, the lift schedule for the typical ring levee section would consist of (Figure B:3-7):

- *Lift 0* – Initial construction with 1 to 2 feet of overbuild.
- *Lift 1* – Levee lift of 2.5 feet performed within 5 to 10 years from initial construction.
- *Lift 2* – Levee lift of 1.5 feet performed within 15 to 20 years of initial construction.
- *Lift 3* – Levee lift of 1 foot performed around 30 years after initial construction.

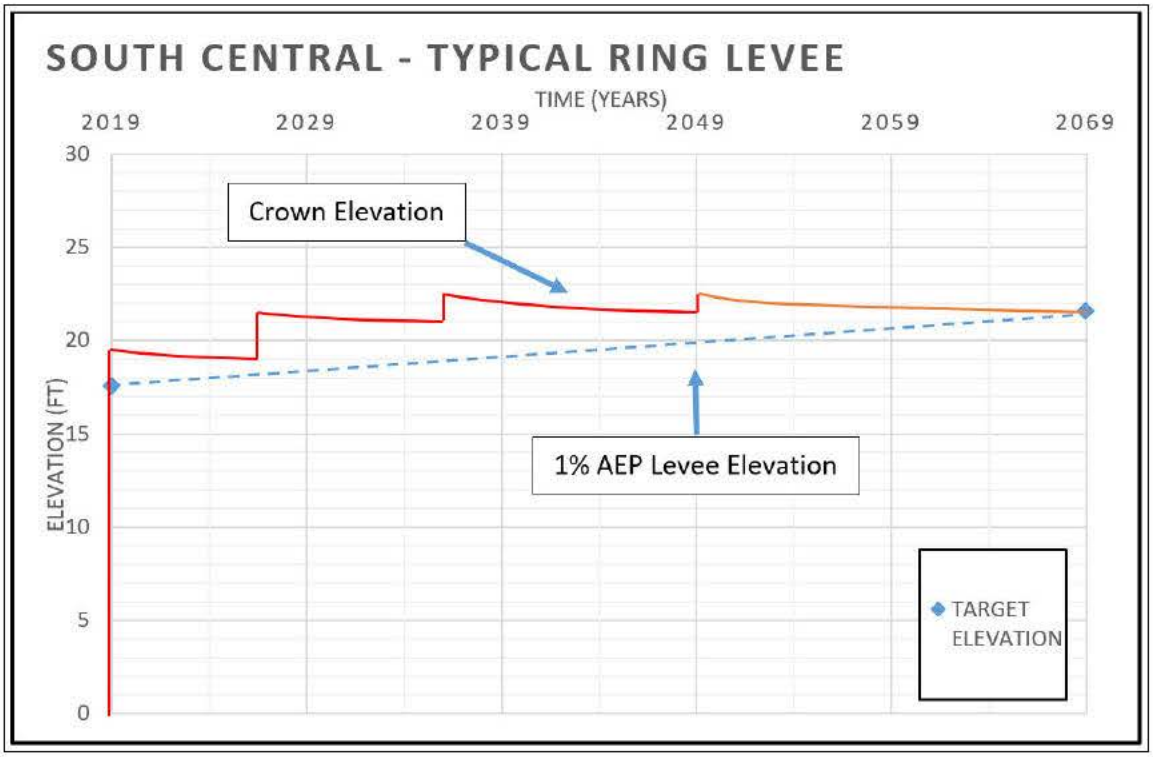

Figure B:3-7. Graphical Representation of Lift Schedule for Typical Ring Levee Section

Once the lift schedule was developed, basic slope stability analyses were performed using GeoStudio's Slope/W (version 10.0.0.17401) computer program. EM 1110-2-1913 and EM 1110-2-1902 were reviewed to evaluate which design conditions would be most critical for design and appropriate factors of safety were selected. Based on this review, it was determined that these conditions should be analyzed using the selected factors of safety (FOS):

- Water at Construction Grade (WCG) (Top of Levee): FOS = 1.2
- Still Water Elevation: FOS = 1.3
- Low Water Elevation: FOS = 1.4

The FOS values are primarily based on EM 1110-2-1913 and HSDRRS (Hurricane and Storm Damage Risk Reduction System) design criteria. Rationale for using FOS = 1.2 for

the WCG condition: the End of Construction (EOC) condition with FOS=1.3 is not likely to govern, as this is a condition with no water loading and is applicable to both flood side and protected side slopes. In fact, HSDRRS states that the EOC conditions are not required given their non-critical nature. The WCG conditions can very well be critical as the embankment is loaded with water to the top of the crown as constructed. A reduced FOS of 1.2 used as this water elevation is less likely to occur as compared to other water elevations analyzed for greater factors of safety.

The 50-year 0.01 AEP ring levee elevations were then reviewed in conjunction with the estimated lift schedule. The maximum 50-year 0.01 AEP elevation was estimated as 25.0 feet with a corresponding Still Water elevation of 13.1 feet. This would require a maximum construction grade elevation of 26.0 feet. This maximum construction grade was used in the analyses along with 10 feet-wide crowns and 1 vertical (V) to 4 horizontal (H) side slopes. For the Still Water analysis, the water elevation was increase to 14.1 feet to account for uncertainties in the 50-year 0.01 AEP predictions. The soil stratification and soil strengths were based on the data from boring POI-4U. The Boring Plate for POI-4U is illustrated in Figure B:3-8. Because this is only a feasibility level study, stability analyses were only performed using Spencer's Method.

Stability analyses results for the Water at Construction Grade, Still Water Elevation, and Low Water conditions are shown in Figures B:3-9, B:3-10, and B:3-11, respectively. All of the analyses met or exceeded the factors of safety used for this measure.

3.2.3 Measures 7, 8 and 9 – Conclusions

Based on the available information, the typical levee section for the ring levees will require a 10 feet wide crown with 1V on 4H side slopes for both the landside and waterside. Depending on actual site conditions, geotextile may be necessary for increased levee stability; particularly if slopes steeper than 1V on 4H are considered. Figure B:3-12 shows the typical levee section for the ring levees. All conclusions are subject to change once site specific boring information becomes available.

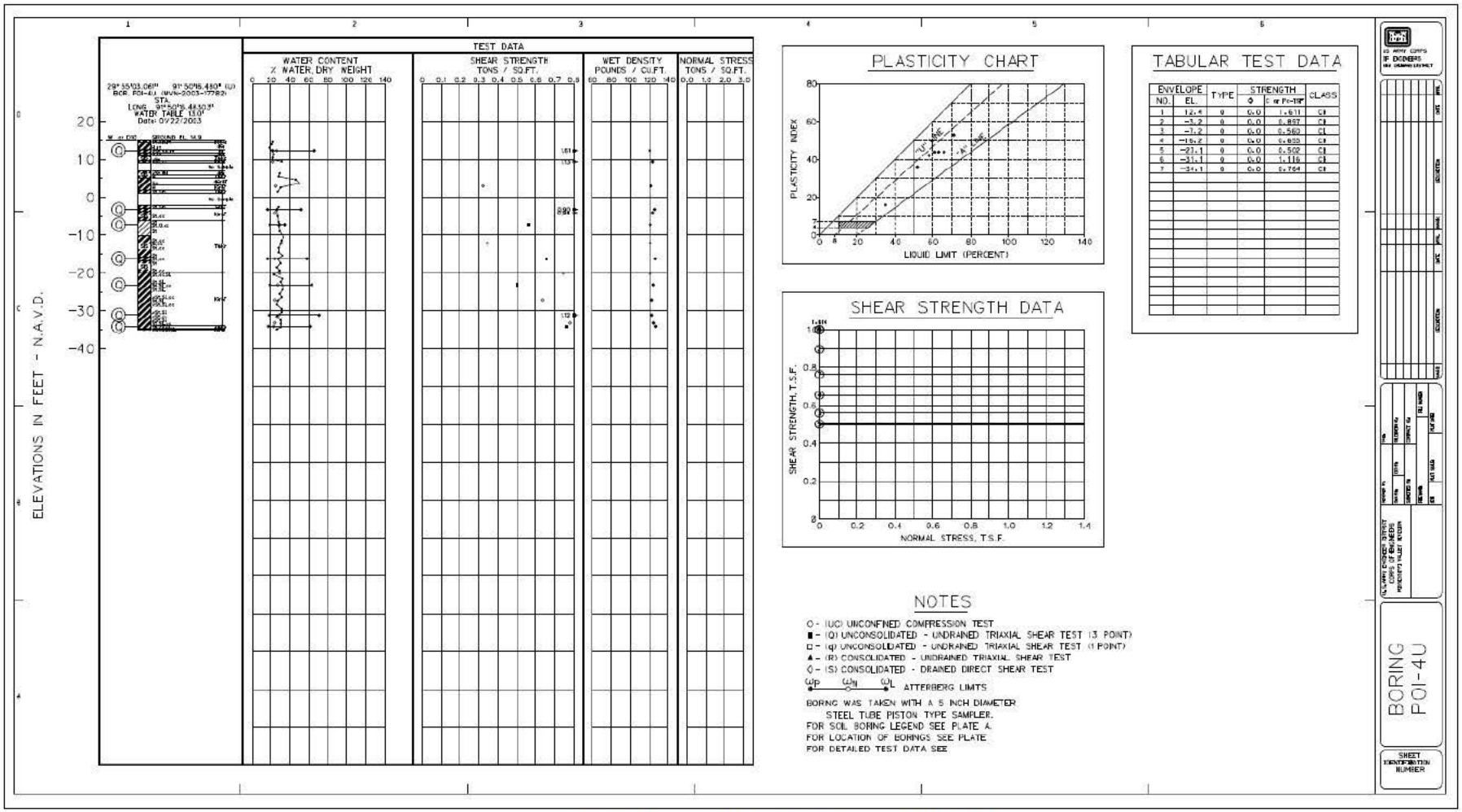

Figure B:3-9. Boring Plate for Boring POI-4U

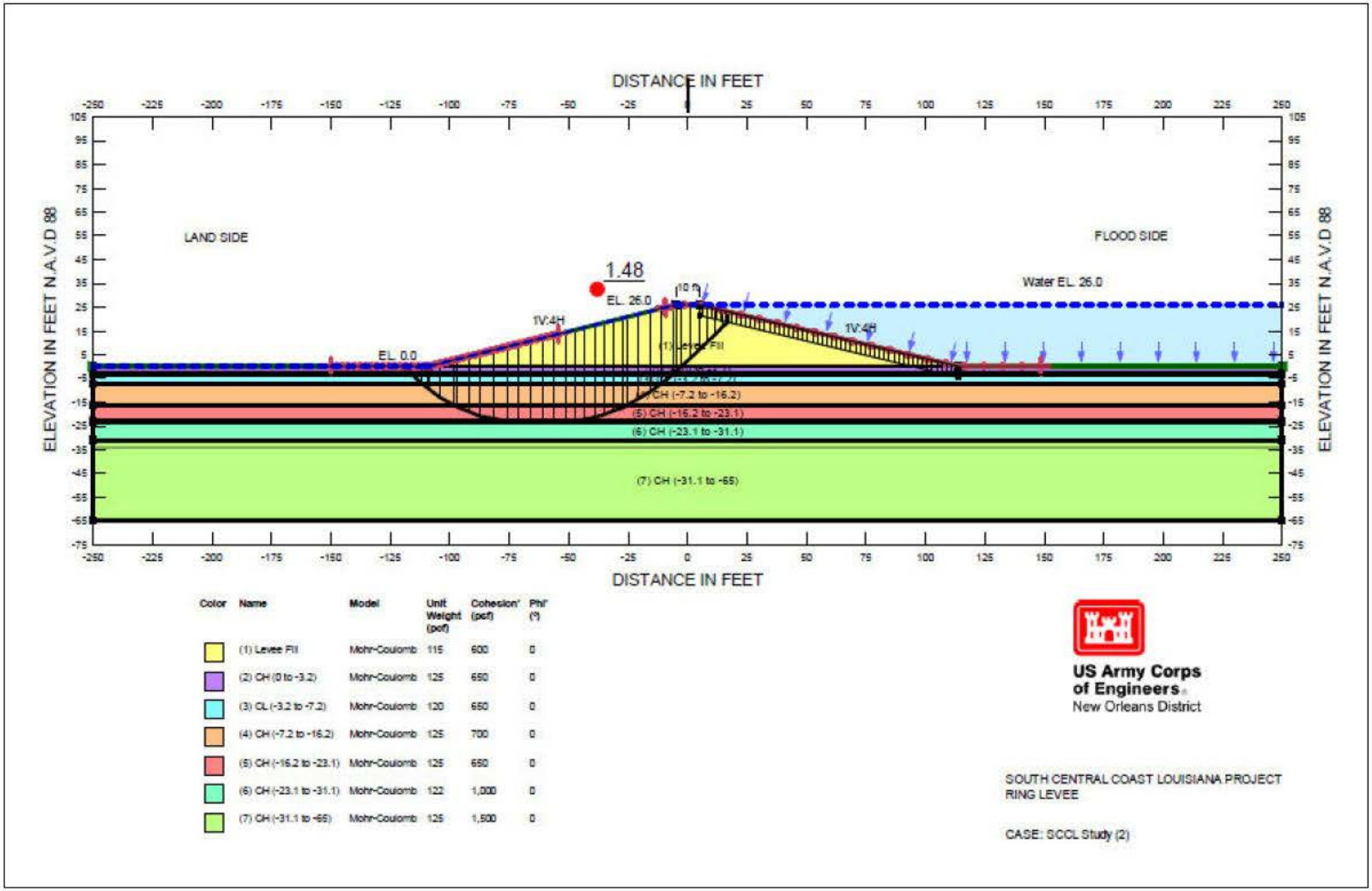

Figure B:3-10. Ring Levees – Slope Stability Analysis for Water at Construction Grade

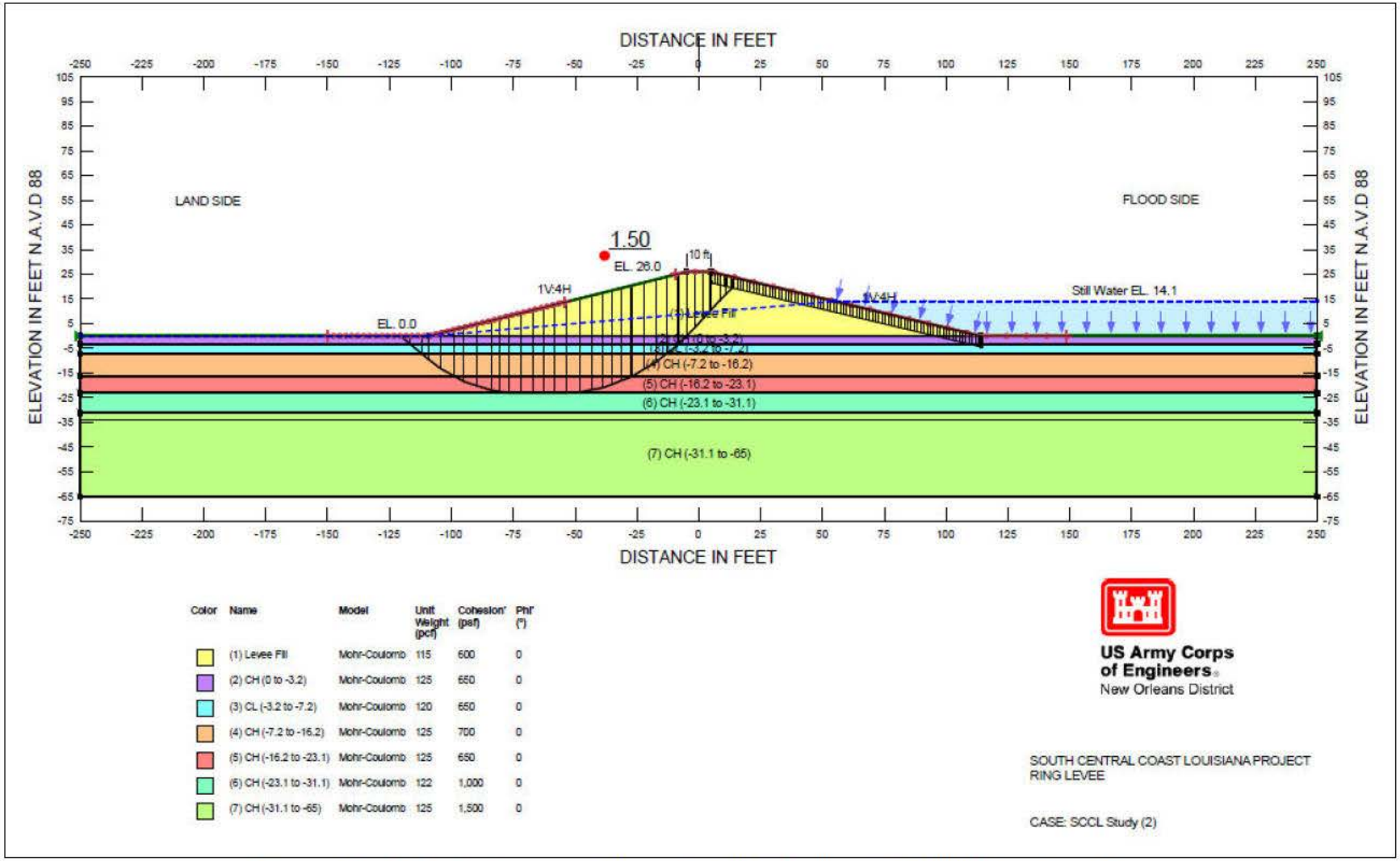

Figure B:3-11. Ring Levees – Slope Stability Analysis for Still Water Elevation

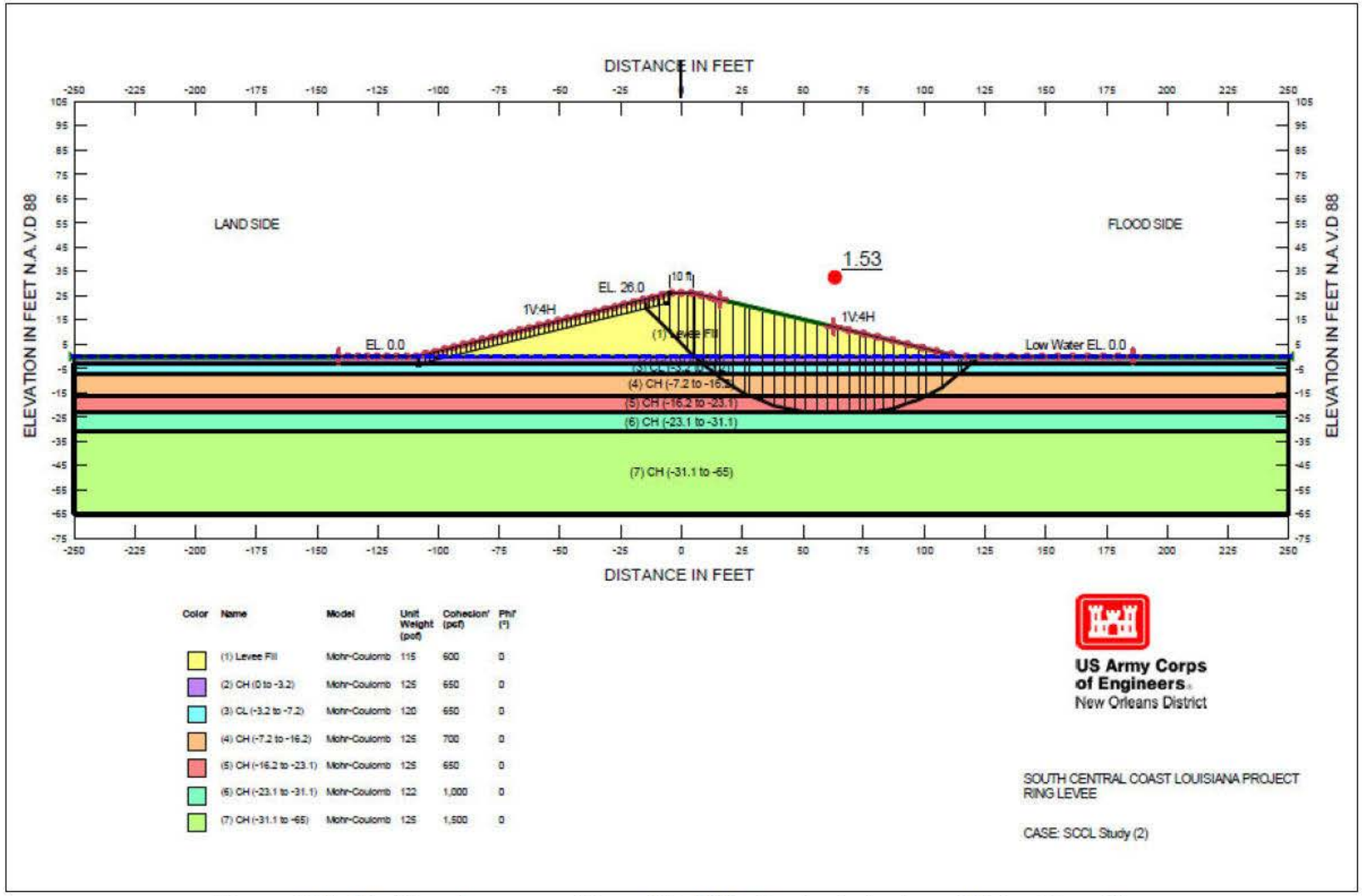

Figure B:3-12. Ring Levees – Slope Stability Analysis for Low Water Condition

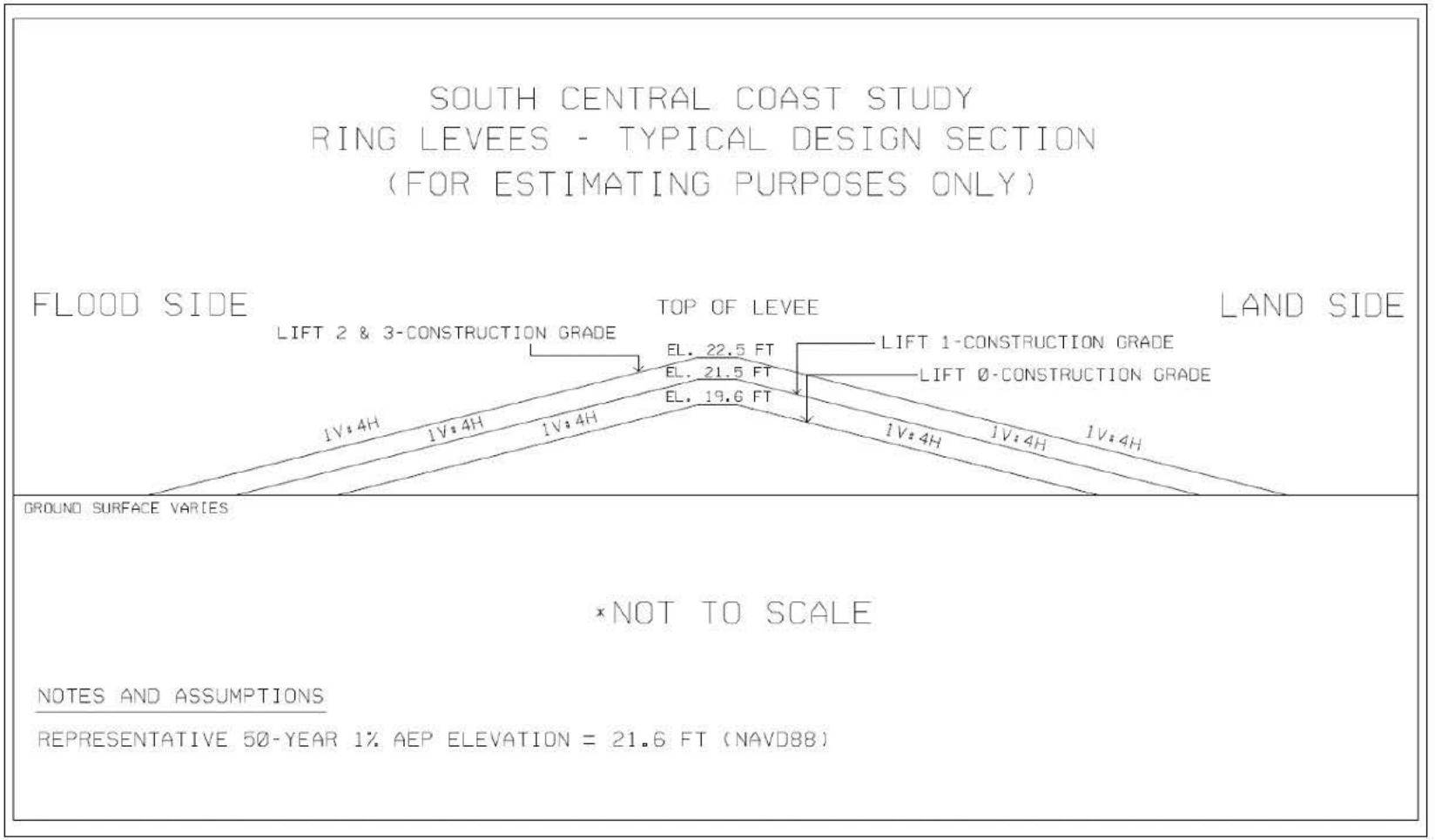

Figure B:3-13. Typical Levee Section - Ring Levees

3.2.4 Measure 5 – Design Assumptions

Measure 5 levee alignment consists of the existing Atchafalaya Basin – Levees West of Berwick from stations 1535+00 to 1690+00 and stations 1845+00 to 2260+00. Portions of Measure 5 were recently raised by the St. Mary Levee and Drainage District to an elevation of 10.5 feet, which meets the 0.01 AEP storm surge levee elevation for this portion of the study area. These recent levee raises occurred between stations 2084+65 to 2260+00. EX-1 levee alignment has an LSAC risk rating of 2 as of the latest inspection and analysis. Measure 5 alignment description is shown on Figure B:3-14 and organized in this section as:

- ***Measure 5 EX1-A***: Ex-1 alignment between stations 1535+00 to 1690+00
- ***Measure 5 EX1-B***: Ex-1 alignment between stations 1845+00 to 2084+65
- ***Measure 5 EX1-C:*** Ex-1 alignment between stations 2084+65 to 2260+00 recently raised by local sponsor

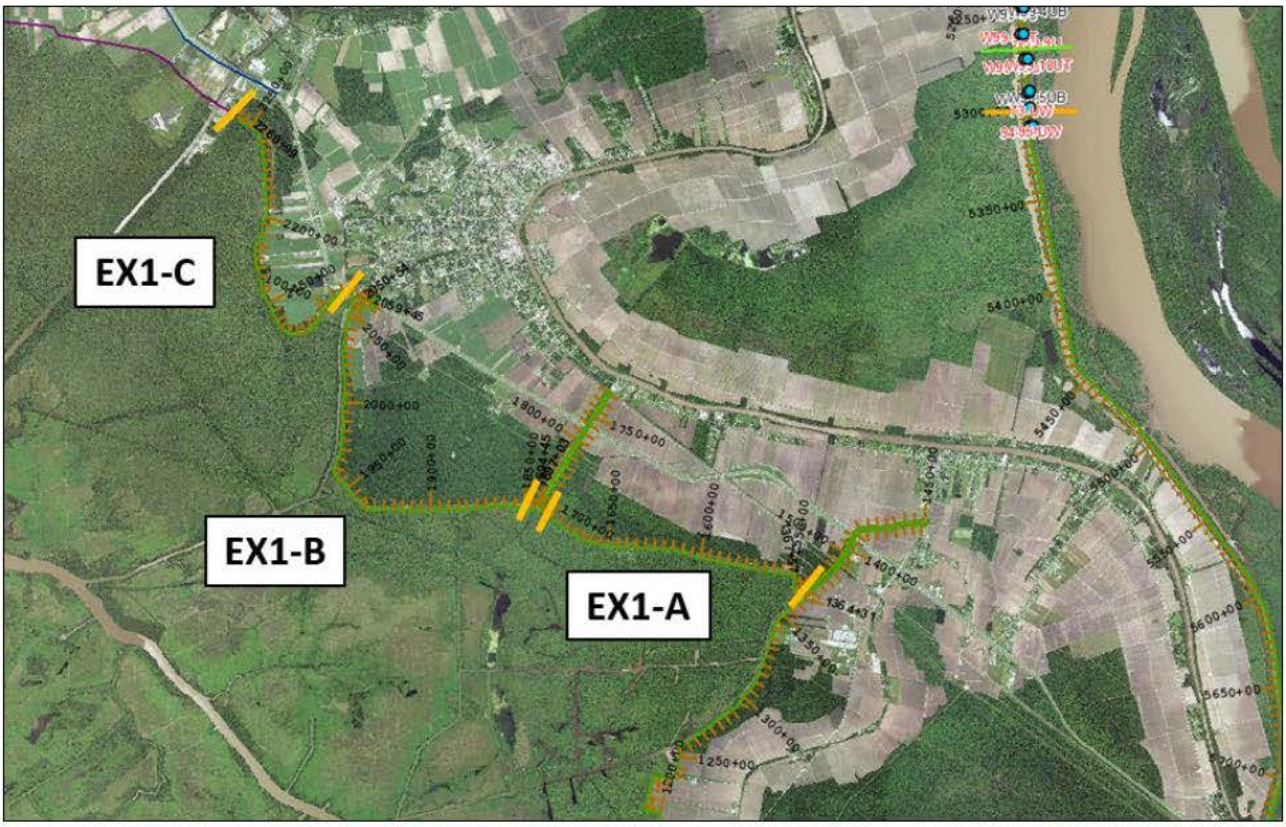

Figure B:3-14. Map Showing Alignment of Measure 5 and Boundaries for Measure 5's EX1-A, EX1-B, and EX1-C

The most recent plans and profiles from 2012, identify the 0.01 AEP elevation along the entire length of Ex-1 alignment at 10.5 feet. Currently, the 0.01 AEP levee elevation has not been forecasted for the 50-year project life of this measure. However, based on USACE experience in the region, the 0.01 AEP levee elevation is roughly estimated to increase

between 4 and 6 feet in the next 50 years. Therefore, a 50-year 0.01 AEP levee elevation of 15.5 feet was assumed for the purposes of estimating a lift schedule.

3.3 MEASURE 5 – DESIGN DEVELOPMENT

The design development for Measure 5 focused heavily on reviewing historic design reports for the existing levees along the Measure 5 alignment. The reports reviewed for this study include:

- Measure 5 *EX1-A*: USACE, 1989. Levees West of Berwick, LA, Teche Ridge Levees, Centerville Area, Station 0+00 to Station 276+00, Design Report with Plans & Profiles, USACE, New Orleans District, New Orleans, LA.
- Measure 5 *EX1-B*: USACE. 1992, Levees West of Berwick, LA, Teche Ridge Levees – Franklin Area, Station 1785+00 to Station 1990+00, Design Study with Plans & Profiles, USACE, New Orleans District, New Orleans, LA.
- Measure 5 *EX1-C*: U.S. USACE, Cappel, Tousley & Moses, Inc., and Kramer & Miller, Inc., 1972. Franklin and Vicinity Area, Design Memorandum No. 1 – General Design, Morgan City, Louisiana and Vicinity, USACE, New Orleans District, New Orleans, LA.

The historic design reports for EX1-A and EX1-B present slope stability and settlement analyses for an all-earth-straddle enlargement design. The reports recommend 10 feet levee crowns with 1 V to 4 H side slopes. The reports estimate less than 1 foot of settlement after construction. Based on the accompanying Plans & Profiles, the average height of fill added for the levee enlargements was generally less than 5 feet.

Historic slope stability and settlement analyses for EX1-C could not be located for review during this study. However, the historic design report recommends 10 feet levee crowns with 1 V to 4 H side slopes. Based on the accompanying Plans & Profiles, the average height of fill added for the levee enlargement was less than 7 feet.

Due to lack of recent consolidation data, updated settlement analyses could not be performed. The historic consolidation data shows that there is a high likelihood that the soils in this area may have been exposed to high pre-consolidation pressures in the past compared to existing in-situ stresses. This is suggested by the settlement parameters used in the historic reports and the relatively low values of estimated settlement (less than 1 foot). However, these conditions would need to be verified with updated testing results. Furthermore, because hydraulic modeling was not performed to estimate the future 0.01 AEP levee elevations, there is a large degree of uncertainty in predicting settlement for a lift schedule since consolidation and settlement are highly time dependent. For these reasons, it is recommended that a lift schedule, similar to that of Measures 7-9, be used for cost estimating purposes.

A typical lift schedule (Figure B:3-15) consists of:

- *Lift 0* – Initial lift with 1 to 2 feet of overbuild.
- *Lift 1* – Levee lift of 2.5 feet performed within 5 to 10 years from initial construction.
- *Lift 2* – Levee lift of 1.5 feet performed within 15 to 20 years of initial construction.
- *Lift 3* – Levee lift of 1 foot performed around 30 years after initial construction.

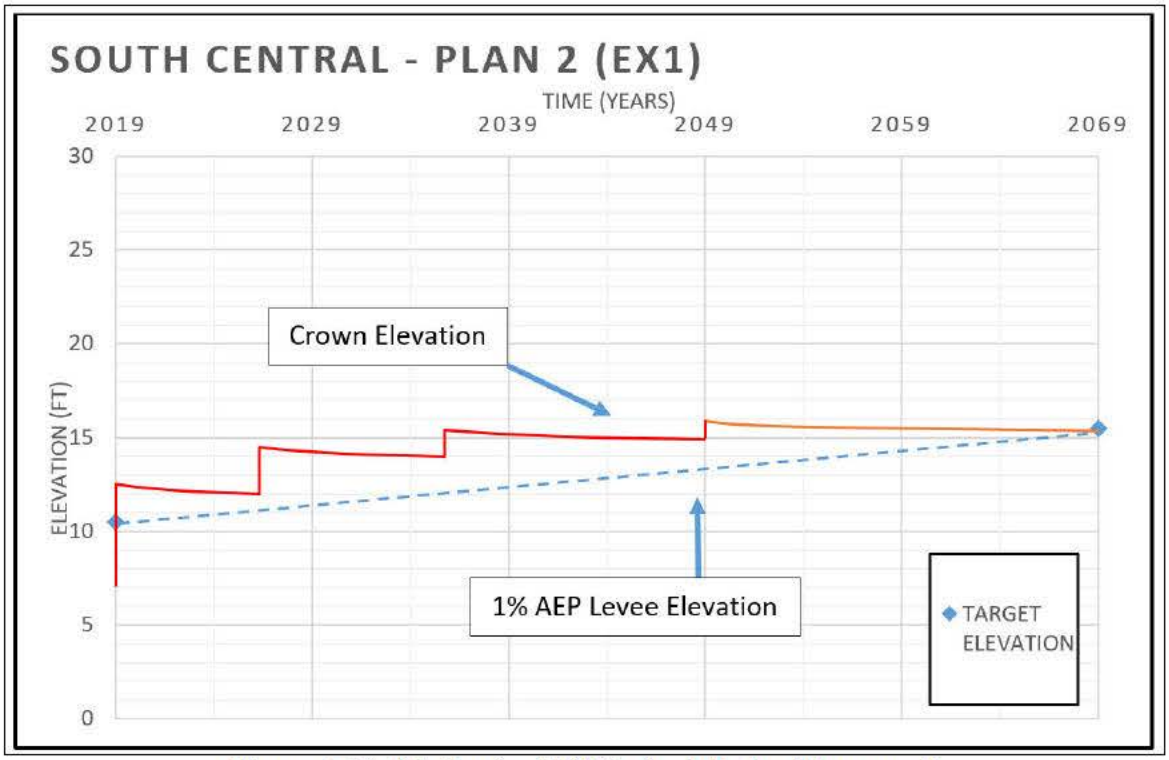

Figure B:3-15. Typical Lift Schedule for Measure 5

Characterization of site conditions for the purposes of performing slope stability analyses were problematic for numerous reasons. Based on the historic reports and Plans & Profiles, the existing surface conditions are expected to vary significantly due to the presence of existing borrow pits and drainage canals in close proximity to the levee alignment. The available sources indicate varying distances from these features to the levee toes. However, 10 feet crown widths with 1 V to 4 H side slopes are consistently recommended in the historic reports. Additionally, there are currently no forecasted predictions for the 50-year 1 percent AEP levee elevation.

Due to the previously stated conditions and lack of data, only a set of basic stability analyses were performed using the historic strength lines and a rough estimate for the maximum construction grade in 50 years. The maximum construction grade was taken as elevation 16.5 feet, which is the estimated 50-year 0.01 AEP levee elevation with an additional 1 foot

for overbuild. These analyses were primarily performed to evaluate the likelihood for requiring stability berms for this measure.

EM 1110-2-1913 and EM 1110-2-1902 were reviewed to evaluate which design conditions would be most critical for design and appropriate factors of safety were selected. Based on this review, it was determined that these controlling cases should be analyzed using the selected factors of safety:

- Water at Construction Grade (Top of Levee): Factor of Safety = 1.2
- Still Water Elevation: Factor of Safety: 1.3

The Water at Construction Grade analysis is presented in Figure B:3-16 and the Still Water Elevation analysis is shown in Figure B:3-17. A distance of 40 feet from the borrow pit to the levee toe was selected for analysis because this is the minimum distance shown in the historic design reports; actual site conditions may vary. Because the 50-year 0.01 AEP Still Water Elevation was unknown for this study, it was estimated to be 3 feet below the estimated 50-year 0.01 AEP levee elevation of 16.5 feet.

It should be noted that although the factors of safety were met for the conditions analyzed in this study, there is large level of uncertainty in the location and depths of nearby borrow pits and drainage canals. These features can have significant influence on the factors of safety for slope stability which could impact the levee design. Furthermore, some gains in soil shear strengths are expected to have occurred between the last time the levees were raised and today.

3.3.1 Measure 5 – Conclusions

Based on the review of the available data and historic reports, it is recommended that any levee raises for Measure 5 use 10 feet wide crowns and 1 V to 4 H side slopes. Based on the results of the slope stability analyses, it is expected that the design section will need to be changed if stricter design criteria are used for geotechnical analysis.

Because the estimated 50-year 0.01 AEP levee elevation was not based on modeling results, it is recommended that a lift schedule similar to that of Measure 7-9 be used for estimating purposes. The typical design section for Measure 5 is shown in Figure B:3-18. All conclusions are subject to change once site specific boring information becomes available.

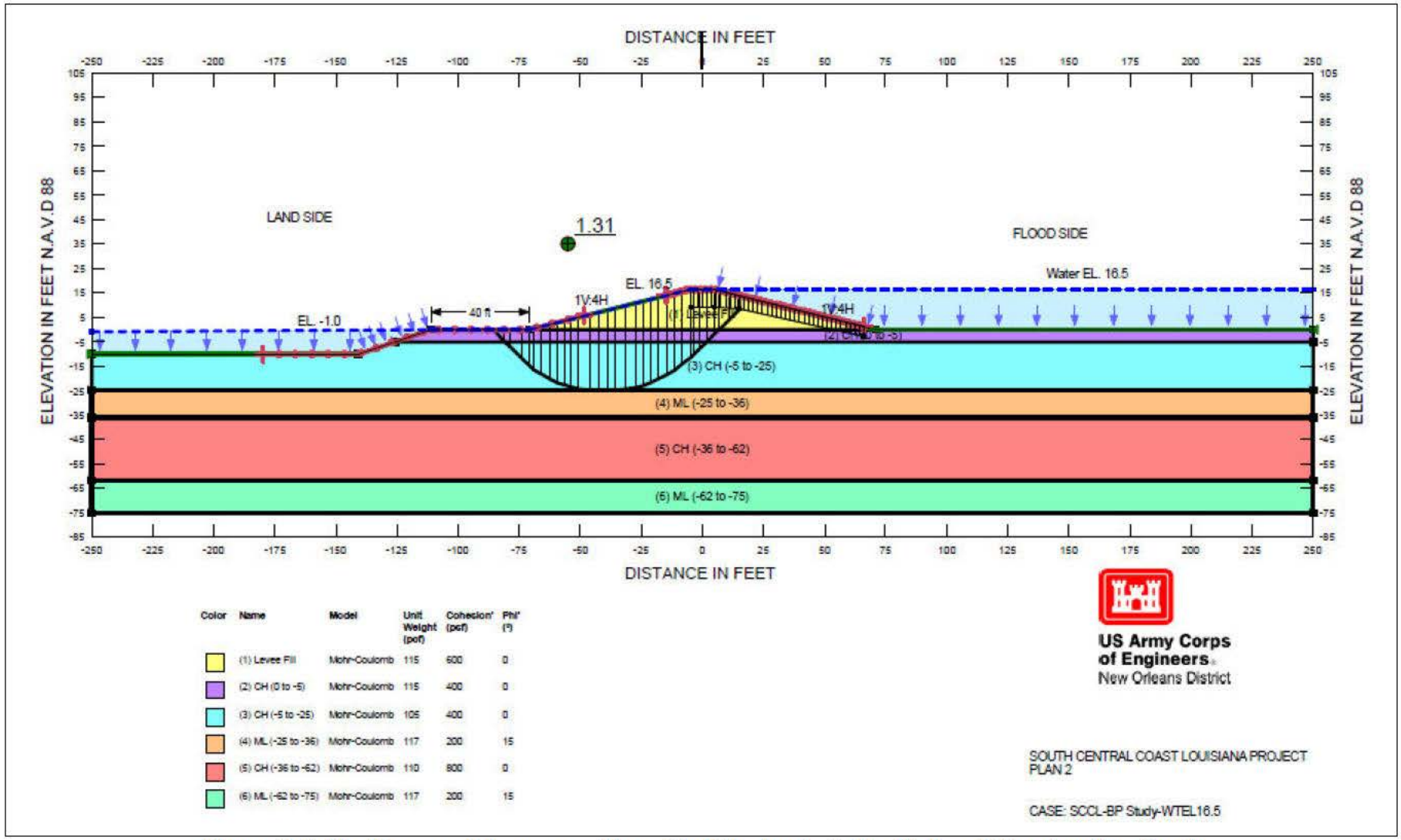

Figure B:3-16. Measure 5 Levees – Slope Stability Analysis for Water at Construction Grade

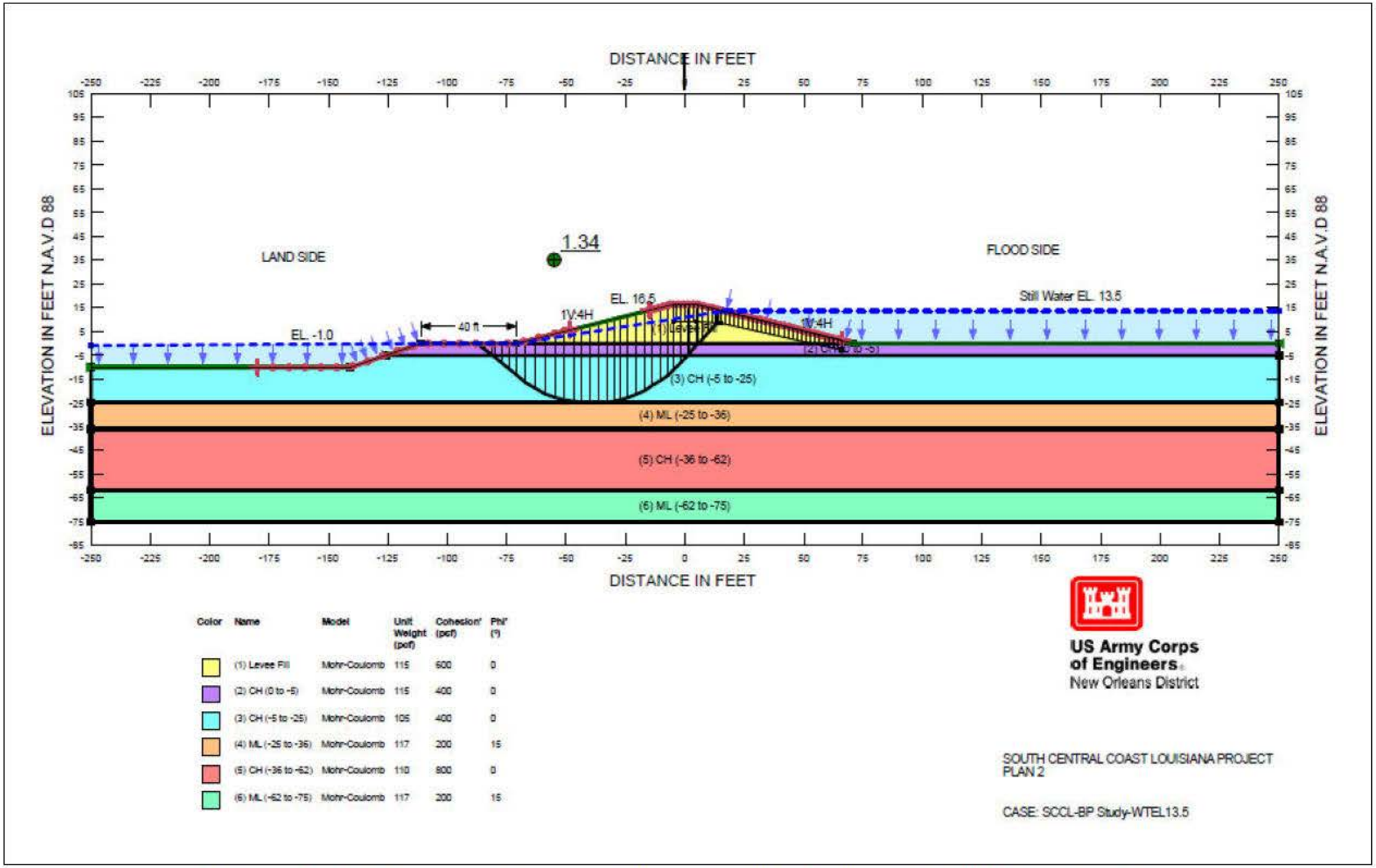

Figure B:3-17. Measure 2 Levees – Slope Stability Analysis for Still Water Elevation

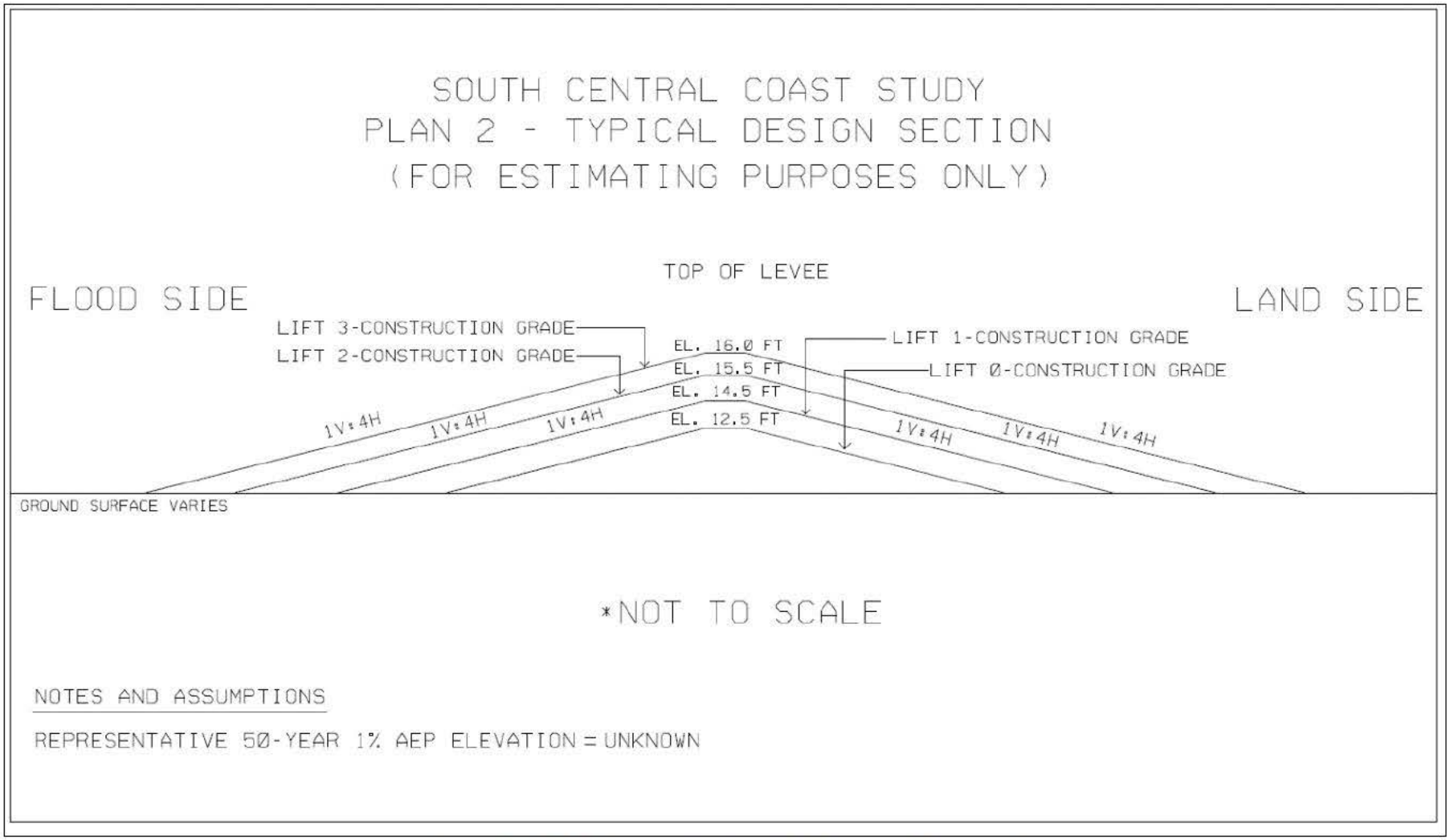

Figure B:3-18. Typical Design Section for Measure 5

3.4 PLAN 3 – NEW LEVEE WOODLAND RD IN EX19 AND NEW I-WALL IN LAKESHORE AREA IN EX21

3.4.1 Measure 6 – Design Assumptions

The Measure 6 alternative is located in Morgan City, Louisiana, as shown in Figure B:3-19. The proposed alternative consists of: (i) installing a new I-Wall along the lakeshore area adjacent to Lake Palourde and (ii) construction of new levee along Woodland Road in southwest Morgan City.

Figure B:3-19. Map Showing Proposed Work Areas for Measure 6 Alternative

The new I-wall would be installed between stations 250+00 and 270+00 along the alignment of the Morgan City back levees as shown in Figure B:3-20 and B:3-21. There are no existing levees along this portion of the alignment but the ground surface is higher than the adjacent lake. There was limited boring information available for review along this portion of the alignment. The closest boring with any testing data is boring 13-AIUT-A, which is approximately 3,500 feet away from the proposed I-wall. The boring was only taken to depth of 11.3 feet. The information from this boring could not be used for geotechnical analysis of the I-wall since the lakeshore area is expected to have significantly different subsurface conditions from those of boring 13-AIUT-A.

Based on the available information, the current (2012) 0.01 AEP levee elevation for this area is approximately 11.0 feet and the existing ground surface along the proposed alignment is approximately at elevation 3.0 feet as shown in Figure B:3-21. The 50-year 0.01 AEP levee elevation was unknown at the time of this study.

The alignment for the proposed levee along Youngs Road is shown in Figure B:3-22. The new levee would raise the elevation in a low area between the Morgan City BNSF Railway

embankment (to the north) and the Atchafalaya Basin – East Atchafalaya Basin Protection Levees (to the south) as shown in Figure B:3-23.

The available boring information along the proposed levee alignment was reviewed and shows that the subsurface consists of 8 to 35 feet of predominantly fat clays (CH) underlain by 20 to 55 feet of silts (ML). However, none of the nearby borings contained strength testing data that could be used to perform slope stability analyses. Additionally, the 50-year 0.01 AEP levee elevation was not forecasted at the time of this study. Due to this incomplete data, it was not possible to develop a typical lift schedule for this alternative.

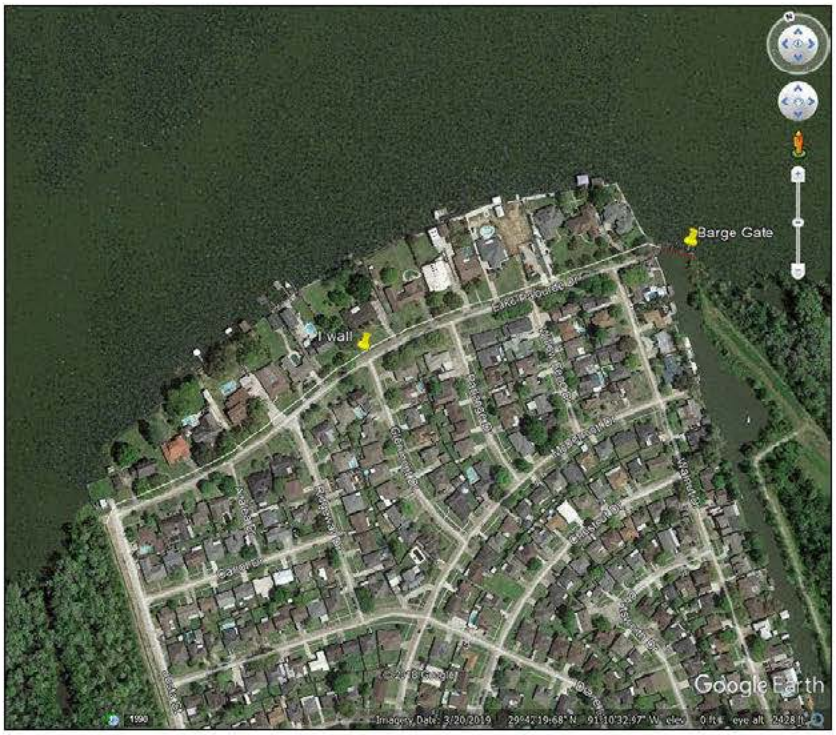

Figure B:3-20. Map Showing Alignment of New I wall and Replacement Barge Gate Adjacent to Lake Palourde

Figure B:3-21. Map Showing Ground Surface Elevations along Lakeshore Area

Figure B:3-22. Map Showing Alignment of New Levee along Youngs Road

Figure B:3-23. Map Showing BNSF Railway Embankment and Atchafalaya Basin Levee Alignments and nearby Boring Locations

3.5 MEASURE 6 – DESIGN DEVELOPMENT

Based on the limited data for both parts of this alternative, geotechnical analyses were not performed for this measure. However, the following guidelines from EC 1110-2-6066 should be considered for estimating cost of the I-wall:

- I-walls are restricted to a maximum 4 feet stick-up and shall extend into the ground at least three times the length that extends above the ground (or at least 10 feet into the ground, whichever is greater).
- I-walls are not allowed along navigation routes due to the potential for barge impacts.
- Scour protection (e.g., unreinforced concrete, rip rap with grout, etc.) shall be placed at least 10 feet wide on the landside of the I-wall for the entire length of I-wall and shall wrap around on the floodside wherever the I-wall transitions into levee. The I-wall shall extend 30 feet into a full levee transition.

For the proposed levees, 10 feet crown widths with 1 V to 4 H slopes can be used for cost estimating purposes based USACE experience in this region. The typical lift schedules presented for Measures 5 and 7-9 can be used for cost estimating purposes.

3.5.1 Measure 6 – Conclusions

Due to limited data, geotechnical analyses were not performed for this alternative. Levees with 10 feet crown widths and 1 V to 4 H side slopes can be used for cost estimating purposes. The typical lift schedules presented for Measure 5 and 7-9 can be used for cost estimating purposes. All conclusions are subject to change once site specific boring information becomes available.

Section 4
Structural Features

The SCCL developed a Class 4 parametric cost estimate for multiple coastal storm surge risk reduction measures. The structures and sizes are included in Tables B:4-1 through B:4-5. The structure locations are along two proposed alignments that were evaluated and reviewed. For the purposes of a parametric cost estimate, all gate widths were sized based on navigational passage interests design criteria. Size estimates were informed by the following study: ARCADIS, U.S., Inc. 2017. *South Central Coast Louisiana Flood Protection Study. Appendix M – Geotechnical Report*. Prepared for the CPRAB.

No design analysis were performed as part of this report. The unit costs were derived based upon historical projects (HSDRRS, NOV, LPV, etc.), where similar structures were designed and constructed. Further design, in addition to updated costs can be provided at the PED level if structures are included in the recommended plan.

4.1 HIGHWAY AND RAILROAD CROSSING

As part of this study, several highway gates were identified for flood protection along Existing Ring Levee 1 and 2 alignments. The required gate opening width that was used as part of this study is 40 linear feet, proposed across a two lane roadway. For cost estimating purposes, an opening width of 34.25 feet was used (similar to WBV-75 project). For the railroad gates, looking at the alignment in google earth, it appears that most of the crossings are single tracks that will traverse the proposed concrete gate monolith and sill. As part of this study, the locations listed in the second column of Tables B:4-1 and B:4-2 were identified for potential road or rail gate crossings.

Table B:4-1 – Proposed Two-Lane, Two Rail (40-ft width) Highway & Railroad Gates

Reach	Location	Reach Elevation	Parish
Ring Levee 1			
Road	Hwy 14 East, Sta. 65+50	17.0	Iberia
Road	Highway 330	16.5	Iberia
Road	Country Drive	15.5	Iberia
Railroad	Railroad Gate, Sta. 373+00	17.0	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Ring Levee 2			
Road	Lee Station Road Gate, Sta. 50+00	17.0	Iberia
Road	Hayes Road Gate, Sta. 121+00	15.5	Iberia
Road	Hwy 329/Avery Island Rd Gate, Sta. 130+00	16.0	Iberia
Road	Hwy 83/Weeks Island Road Gate (3)	16.5	Iberia
Road	Par Road 271 Road Gate		Iberia
Road	Hwy 90 E Frontage Road Gate, Sta. 502+00		Iberia
Ring Levee 1			
Road	Hwy 14 East, Sta. 65+50	17.0	Iberia
Road	Highway 330	16.5	Iberia
Road	Country Drive	15.5	Iberia
Railroad	Railroad Gate, Sta. 373+00	17.0	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Ring Levee 2			
Road	Lee Station Road Gate, Sta. 50+00	17.0	Iberia
Road	Hayes Road Gate, Sta. 121+00	15.5	Iberia
Road	Hwy 83/Weeks Island Road Gate (3)	16.5	Iberia
Road	Par Road 271 Road Gate		Iberia
Road	Hwy 90 E Frontage Road Gate, Sta. 502+00		Iberia

Table B:4-2. Proposed Cost of the Railroad and Highway Gates

Gate Type:	Estimated Total Costs:
Two-Lane Highway Crossing Gate	$4.75 - 5.5M
Railroad Gate	$5.0M

***Note that these costs above are for an average wall height of 9.0 to 9.5-feet.

The proposed levee alignments were analyzed using the Louisiana Department of Transportation and Development geographic information system (GIS) database, along with satellite aerial photography, to identify and size all major road and railroad crossings. Minor crossings, such as rural roads in agricultural fields, were not included in this analysis because slight levee grade alterations could be made to accommodate agricultural equipment in future studies. All gates were sized to maintain current service capacity. All roadway gates were assumed to be two-lane roller gates. All required railroad gates service single track crossings and were sized accordingly.

4.2 PUMPING STATIONS

The CPRAB, U.S., Inc. 2017 study, identified necessary pumping capacity and floodgates using hydrologic and hydraulic modeling. The model included several canals listed in Table B:4-3, which provided information for preliminary design for pump stations. As with the identification and sizing of the drainage structures, forced drainage of storm water runoff was separated into two basic classifications: areas with existing levee and forced drainage systems including the existing Atchafalaya levee system and Morgan City Back Levees; and those areas with no existing levee or forced drainage systems, including the proposed Iberia and St. Mary Parish alignments, which are currently served through a vast network of gravity drainage natural bayous, canals, ditches, and conduits.

As part of this study, an assessment of pumping and floodgate requirements was made for the canals that intersect the proposed levee reaches. The canals shown in Table B:4-3 also include the estimated pumping capacity per canal location. EDS used this capacity to develop a ROM Cost Estimate. A total cost of $25,000 per cfs was used for cost estimating purposes. The cost in Table B:4-3 include the structure, mechanical and electrical components, foundation, and fronting T-Walls. Updated design and costs can be provided at PED level of the project.

Table B:4-3. Proposed Pump Stations Locations & Costs (which include required Pumping Capacity)

		Pump Station (cfs)	Total Costs
Iberia Parish	Delcambre/Avery Canal	1,530	$ 38,250,000.00
	Poufette Canal	3,720	$93,000,000.00
	Petit Anse Canal	5,800	$127,600,000.00
	Commercial/Rodere Canal	5,200	$114,400,000.00
	Delahoussey Canal	2,420	$60,500,000.00
St. Mary Parish	Ivanhoe Canal	90	$2,250,000.00
	Bayou Cypremort	790	$19,750,000.00
	Bayou Choupique	2,440	$61,000,000.00
	Bayou Teche/Charenton Canal	4,000	$88,000,000.00

4.3 NAVIGABLE GATES

The navigable gate structures along the alignment facilitate transportation, maritime navigation, and/or storm water runoff drainage. These structures were identified through a three-step process. The initial step was to use the structures identified in previous studies as a baseline inventory. For existing structures, top-of-structure elevations from LSER surveys were compared with required 0.01 AEP storm surge elevations to discern if they were acceptable. As discussed in Section 5, no replacements of existing gates or locks were deemed necessary. In a parallel effort, the baseline inventory of proposed gates was compared to the proposed Iberia and St. Mary alignments and the existing reaches requiring lifts to refine the number, type, and location of required structures. Finally, through research of planned future transportation and navigation enhancement projects, remote sensing data analysis of channel cross sections, and satellite imagery analysis, the structures were categorized by the types of gates required. For this study, all newly proposed navigable gate structures were categorized into three basic groups:

- Small, 30-foot-wide sinkable barge swing-type steel gates
- Large, 110-foot-wide sinkable barge swing-type steel gates
- Extra-large, 200-foot sinkable barge swing-type steel gates.

For cost estimating purposes, EDS used a cost per linear feet of $275,000 per gate location based upon the required opening size. EDS used the costs and opening width of previous hurricane projects to derive the ROM cost per linear feet. The costs shown in Table B:4-4 include construction of the steel gate, concrete monolith (walls & base slab), monolith

foundation, electrical and mechanical components, and control house. Updated costs will be provided during PED level, if measures are included in recommended plan.

Table B:4-4. Proposed Navigational Gate (Steel Barge Gate):

		Barge Gate Size	Total Costs
Iberia Parish	Delcambre/Avery Canal	110	$30,250,000.00
	Poufette Canal	30	$8,250,000.00
	Petit Anse Canal	30	$8,250,000.00
	Commercial/Rodere Canal	200	$55,000,000.00

4.4 DRAINAGE STRUCTURES

For the existing alignment ring levee 1 +2 and 2 alignment, several drainage structures were identified and required across several drainage canals. The proposed drainage structures and locations are shown in Table B:4-5. The unit costs for the drainage structures were taken from existing project WBV-72a and NOV-5a.1, which utilized similar structures and wall heights. A typical drainage structure is show on Figure B:4-1.

Table B:4-5. Proposed Drainage Structures (Sluice Gates)

Reach	Location
Iberia	Jefferson Canal (Drainage Structure), Sta. 300+00
Iberia	Hayes Coulee (Drainage Structure), Sta. 70+00
Iberia	Emma (Drainage Structure), Sta. 139+00
Iberia	Segura Road West (Drainage Structure), Sta. 166+00
Iberia	Segura Road East (Drainage Structure), Sta. 185+00
Iberia	Peebles Coulee (Drainage Structure) (4)

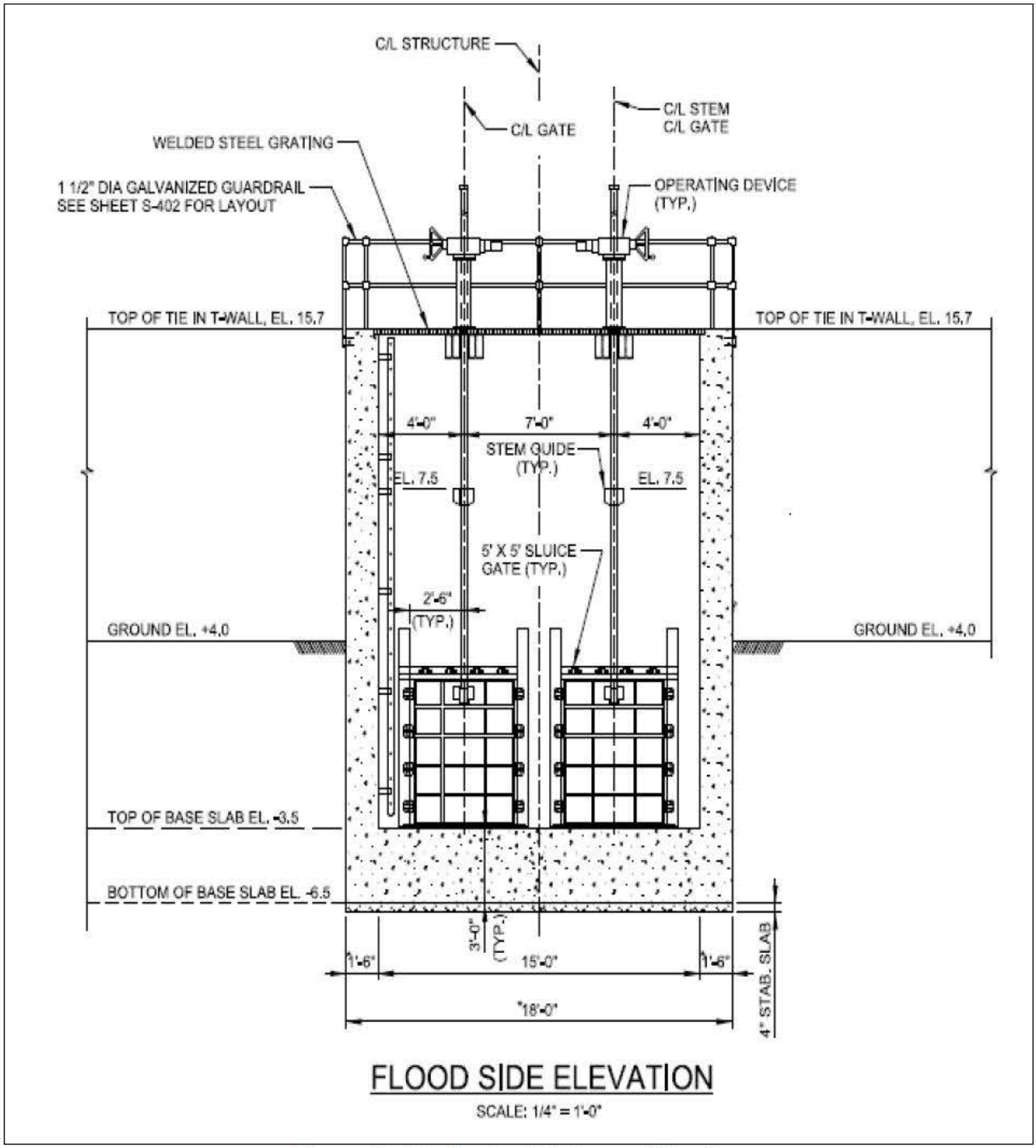

Figure B:4-1. Typical Drainage Structure

Section 5

Operation, Maintenance, Repair, Replacement, and Rehabilitation

Operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) estimates were not determined due to all structural measures being screened and only non-structural measures being selected.

Section 6
Cost Estimates

The cost estimates for the measures and alternatives were prepared based on readily available MVN data and quantities provided by the project delivery team (PDT). The cost estimate was developed in the TRACES Mii cost estimating software and used the standard approaches for a feasibility estimate structure regarding labor, equipment, materials, crews, unit prices, quotes, and sub- and prime contractor markups. All features were estimated based on standard construction methods that are common to MVN and South Louisiana. The estimates assumed access was available to proposed areas unless otherwise stated. This philosophy was taken wherever practical. It was supplemented with estimating information from other sources, where necessary, such as quotes, historical bid data, A-E estimates, and previously approved similar studies (Southwest Coastal Louisiana Study, Morganza to the Gulf). The intent was to provide or convey a "fair and reasonable" estimate that depicts the local market conditions. Detailed cost estimate information not related to the structural alternatives can be found in Appendix M. Costs.

6.1 STRUCTURAL MEASURES COST ESTIMATE WORKFLOW PROCESS

At each step in the screening process, different levels of cost estimates were calculated. For initial screenings of measures in which the PDT had initial cost estimates, such as the CPRA State Master Plan Alignment and the Highway 90 Alternative, the cost estimates from the Arcadis report (Arcadis, 2017) (Tables B:6 7-21) were used, along with the economics benefits calculated by the PDT, to determine an initial BCR. The intent of this was to identify any measures that either passed an initial screening or could be identified as close to a unity BCR and thus required more investigation and refinement of the cost estimates to determine a final BCR. In this scenario, neither the CPRA State Master Plan alignment nor the Highway 90 alignment were close to unity and were therefore screened.

After the PDT reviewed other possible measures based upon economic impact clusters (Measure 5- Levees West of Berwick, Measure 6- Morgan City Back Levee, Measure 7- Ring Levees 1, Measure 8- Ring Levee 2 (and Measure 8 var.- Ring Levee 1+2) and Measure 9- Ring Levee 3, respectively), cost estimates for levees were developed using quantities based upon typical sections and existing ground elevations or existing levee elevations, depending upon the scenario. In addition, known pipeline crossings that would need to be raised were identified and costs were determined based upon historical costs for pipeline crossings. For all gates, barge gates, and all other non-levee structural features, the length of those proposed features were measured (using aerial imagery) and costed using historical costs of similar non-levee structural features.

Measures 5-9 initially had a BCR closer to unity. Therefore, more investigation and research was initiated and cost estimates were refined further. For these measures, as much information as was available was gathered and included in the cost estimates (Tables B:6 1 through B:6-6) to determine a more resilient BCR. After the BCR was calculated, the PDT

was informed that the initial determination that all structural measures were to be designed using EM 1110-2-1913 criteria was incorrect and that the more robust HSDRRS criteria was to be used. At this point in the process, only Measure 6- Morgan City was near a BCR unity. It was determined that due to additional costs associated with the HSDRRS criteria, any further investigation and refinement of costs for the structural measures would be purely academic and not provide any viable structural measures meeting or exceeding unity.

6.2 STRUCTURAL MEASURES ESTIMATE ASSUMPTIONS

Estimate Structure: The estimate is structured to reflect the projects performed. The estimates are subdivided by alternative alignments.

Bid competition: It is assumed that there will not be an economically saturated market and that bidding competition will be present.

Contract Acquisition Strategy: It is assumed that the contract acquisition strategy will be similar to past projects with some negotiated contracts, focus and preference of small business/8(a), and large, unrestricted design/bid/build contracts. There is no declared contract acquisition plan/types at this time, so typical CEMVN goals have been included.

Labor Shortages: It is assumed there will be a normal labor market.

Labor Rates: Local labor market wages are above the local Davis-Bacon Wage Determination and actual rates have been used. This is based upon local information and payroll data received from the CEMVN Construction Representatives and estimators with experiences in past years.

Materials: Cost quotes are used on major construction items when available. Recent quotes may include borrow material, concrete, steel and concrete piling, rock, gravel, and sand. Assumptions include:

- Materials will be purchased as part of the construction contract. The estimate does not anticipate government furnished materials. Prices include delivery of materials.
- Concrete - will be purchased from commercial batch plants.
- Borrow Material and Haul - Borrow material is considered the highest risk in the contracts, given the large quantities required, uncertainties of sources and materials near the many contract locations. Specific borrow sources have not been established so a conservative estimated haul distance was used when using off-site material. Borrow pits currently in use are within this distance. Borrow material for the measures are assumed Government furnished borrow. Adjacent borrow pits to the levees were eliminated at this stage due to previous utilization of adjacent borrow pits to existing levees and the existing infrastructure and development to new levees.

The borrow quantity calculations followed the CEMVN Geotechnical guidance:

- Hauled Levee: 10 BCY (bank cubic yards) of borrow material = 12 LCY (loose cubic yards) hauled = 8 ECY (embankment cubic yards) compacted.

- An assumed average one-way haul distance of 20 miles was used unless a committed borrow source has been confirmed available. This decision is based upon discussions with CEMVN cost engineers and PDT.
- Haul speeds are estimated using 40 mph speed average given the long distances and rural areas.

Staged construction was eliminated as a potential cost savings measure based on historic levee performance in the vicinity of the study area. Levee slopes steeper than 1V:4H have been known to have issues with slope instability, with slides occurring regularly in the study area. Therefore, given CEMVN's experience with constructing levees in the project area, we do not believe cost savings using staged construction would result in a B/C ratio over 1.0.

The fourth iteration B/C ratios intentionally over estimated benefits and assumed 100 percent of the damages were mitigated over the 50-year life of the project. Along with the over estimation in benefits, costs were based upon standard levee design (rather than HSDRRS design criteria) which was an intended underestimation. Fourth iteration B/C cost ratios of 0.66, 0.36, 0.42, and 0.96 were the result of the overestimation of benefits and the underestimation of costs. The B/C ratios (all of which were below unity) are anticipated to significantly decrease during refined evaluations as a result of design criteria and refined 50 year damage assumptions. Additionally, Measure 6-Morgan City Back levees under standard design criteria cost only included closing existing unprotected sections.

If HSDRRS criteria would be applied to the Morgan City Back levees, the required HSDRRS criteria would require all of the Morgan City levees/floodwalls to be replaced with “T” walls (currently all floodwall/levees are “I” walls and do not have the higher stability required under the HSDRRS design criteria). This would result in significant cost increases without additional benefits being accumulated.

Rock and stone - The Louisiana area has no rock sources. Historically, rock is barged from northern sources on the Mississippi River. This decision is based upon local knowledge and experience and is supported with cost quotes.

Equipment: Rates used are based from the latest USACE EP-1110-1-8, Region III. Adjustments are made for fuel, filters, oil, and grease (FOG) prices and facility capital cost of money (FCCM). Use of owned verses rental rates was considered based on small business, large business, and local equipment availability.

- Trucking: The estimate assumed independent self-employed trucking subcontractors due to the large numbers of trucks required.
- Dozers: dozers of the D-5/D-6 variety were chosen based on historical knowledge. Heavier equipment gets mired in the mud and soft soils.
- Severe Rates: Severe equipment rates were used where appropriate.

Fuel: Fuels (gasoline, on and off-road diesel) were based on local market averages for on-road and off-road. The PDT found that fuels fluctuate irrationally and used an average.

Crews: Major crew and productivity rates were developed and studied by senior USACE estimators familiar with the type of work. All of the work is typical to MVN. The crews and productivities were checked by local MVN estimators, discussions with contractors, and comparisons with historical cost data. Major crews include haul, earthwork, piling, concrete, and deep soil mixing.

Unit Prices: The unit prices found within the various project estimates will fluctuate within a range between similar construction units such as floodwall concrete, earthwork, and piling. Variances are a result of differing haul distances (trucked or barged), small or large business markups, subcontracted items, designs, and estimates by others.

Relocation Cost: Relocation costs are defined as the relocation of public roads, bridges, railroads, and utilities required for project purposes. Due to the limited time available for investigation, only pipeline utility costs were computed.

Mobilization: Contractor mobilization and demobilization are based on the assumption that many of the contractors will be coming from within a 500 mile radius. Based on historical studies, pre- Hurricane Katrina detailed Government estimates for mobilization averaged 4.9 to 5 percent of the construction costs. The estimate utilizes the approximately 5 percent value at each contract. The 5 percent value matches well with the 5 percent value prescribed by Walla Walla District, which has studied historical rates.

Field Office Overhead: The estimate used a field office overhead rate of 12 percent for the prime contractor at budget level development. Based on historical studies and experience, Walla Walla District has recommended typical rates ranging from 9 percent to 12 percent for large civil works projects. The 12 percent rate considers the possibility of maintenance and management of work camps and kitchens. The applied rates were previously discussed on similar projects among numerous USACE district cost engineers including Walla Walla, Vicksburg, Norfolk, Huntington, St. Paul, and New Orleans.

Overhead assumptions include: Superintendent, office manager, pickups, periodic travel, costs, communications, temporary offices (contractor and government), office furniture, office supplies, computers and software, as-built drawings and minor designs, tool trailers, staging setup, utility service, toilets, safety equipment, security and fencing, small hand and power tools, project signs, traffic control, surveys, temp fuel tank station, generators, compressors, lighting, and minor miscellaneous.

Home Office Overhead: Estimate percentages range based upon consideration of 8(a), small business and unrestricted prime contractors. The rates are based upon estimating and negotiating experience, and consultation with local construction representatives. Different percentages are used when considering the contract acquisition strategy regarding small business 8(a), competitive small business and large business, high to low respectively. The applied rates were previously discussed on similar projects among numerous USACE district cost engineers including Walla Walla, Vicksburg, Norfolk, Huntington, St. Paul, and New Orleans.

Taxes: Local taxes will be applied, using an average between the parishes that contain the work. Reference the Louisiana parish tax rate website: http://www.laota.com/pta.htm

Bond: Bond is assumed 1 percent applied against the prime contractor, assuming large contracts. No differentiation was made between large and small businesses.

Contingency: An abbreviated cost risk analysis was performed with the PDT identifying associated risks with the estimated costs shown in the report. Through this analysis, a contingency for each alternative was identified. The contingency ranged from 25 percent for real estate costs to 46 percent for Alternative 3 construction costs. See the individual alternative cost tables for each alternative's calculated contingency.

E&D and S&A: USACE Costs to manage design (PED) and construction (S&A) are based on MVN Programmatic Cost Estimate guidance:

- Planning, Engineering & Design (PED): The PED cost includes such costs as project management, engineering, planning, designs, investigations, studies, reviews, value engineering, and engineering during construction (EDC). Historically, MVN has used an approximate 12 percent rate for E&D/EDC, plus 8 percent for other support features for a total of 20 percent. This percentage is applied against the estimated construction costs.
- Supervision & Administration (S&A): Historically, a range from 5 percent to 15 percent, depending on project size and type, applied against the estimated construction costs for USACE projects. Other USACE civil works districts such as St. Paul, Memphis, and St. Louis report values ranging from 7.5-10 percent. Consideration includes that a portion of the S&A effort could be performed by contractors. Currently, MVN utilizes an S&A rate of 9 percent for this type and size of project.

6.3 STRUCTURAL MEASURES COST RISK AND UNCERTAINTY

Emergent and forested wetlands were not accounted for in Real Estate costs.

Relocation costs are defined as the relocation of public roads, bridges, railroads, and utilities required for project purposes. Due to the limited time available for investigation, only pipeline utility costs were computed.

Foundation Design: No site specific boring data was available for this effort. Existing data in the vicinity was used to develop levee designs. One levee design was done for use in all new levee measures.

Structures: An effort was made to identify the major structures that would be required, but it is possible that more structures would be needed.

Mitigation requirements not required.

A conservative estimate was assumed for Real Estate Requirements for all levee measures.

Pumping requirements used were considered minimal amounts. Actual requirements may be different. Additional drainage work may be needed to get the water to the pumping stations.

Levee alignments were developed using existing mapping. These preliminary alignments were used to develop cost estimates. Alignments may need to be shifted to avoid existing structures or for other reasons.

Quantities developed assume levee for the entirety of each alignment. There is a possibility that some reaches of floodwall may be needed in more developed areas.

Because no borrow sites have been identified, borrow was assumed to be available within a 20 mile radius. Borrow may be available at a closer distance.

The base estimate assumes open and competition bidding which is the traditional employed contract procurement method. However, often competition will be limited due to certain small groups of pre-approved contractors, or with the intent of improving overall quality of construction (best value procurements). The house elevating costs are based on the limited pool available in the Louisiana area, so some limited competition could be considered to already be built into the costs. There is a risk not knowing exact implementation plan could cause increased levels of tiered subcontracting and/or limit the pool of contractors.

Due to the extended period of completion there could be future design/technical changes to design criteria or hydraulic analysis that would result in increased requirements and cost.

One typical ROW width for Real Estate estimates was utilized for parametric cost estimates. This width will be used to develop a Real Estate estimate for measure and alternative alignment costs.

Use of limited data may result in under designing project features.

Future levee lifts were included in future with project cost estimates. All final array measures did not include straight O&M costs. Following TSP, develop O&M estimates for included project features. Costs may be underestimated leading to an unrealistic expectation by the Local Sponsor as to their requirements.

There is the potential for a high water event to occur during construction which could result in longer construction period and additional cost due to storm damage.

Engineering and cost estimates on structural project features were developed from other similar studies and constructed projects. Future lifts and OMRR&R estimate for the recommended plan will be further refined during feasibility level of design.

Borrow material was assumed that environmental resources investigations would allow for significant impacts to be avoided. Cost estimates assume 20 mile haul costs for source material. Source material distance may change. Investigations for environmental re- sources may result in an impact to project schedule during final design.

Change in USACE design guidance and or interpretation could result in redesign and/or reanalysis.

Using existing data including geotechnical and H&H from outside sources, data may be several years old and not representative of current conditions.

LOP raises affected structure foundations which would result in structures needing to be replaced in lieu of raising.

Unknown subsurface conditions, or assumptions based on regional data that may not represent conditions within project area

LSAC rating could change on levees within study area resulting in changes to risk or consequences

Seepage or stability berms may occur during study or in PED phase resulting in additional berms, increasing costs.

HTRW material may be within the project area and areas of levee alignment, resulting in increased costs.

Table B:6-1. Measure 7- Ring Levee 1 Cost Estimate (table indicates "Alternative 1," the data shown is correct for Measure 7, Ring Levee 1)

Alternative 1 - Ring Levee 1

Updated 14-Jan-20

Estimate of Probable Cost for Alternate 1

WBS	DESCRIPTION	COST	Contingency	Contingency Cost	TOTAL COST
01	Lands and Damges	$21,447,200	25%	$5,361,800	$26,809,000
02	Relocations	$11,632,000	40%	$4,652,800	$16,284,800
06	Fish and Wildlife Facilities	-			
11	Levees and Floodwalls	$340,484,000	40%	$136,193,600	$476,677,600
15	Floodway Control & Diversion Structure	$42,000,000	40%	$16,800,000	$58,800,000
18	Cultural Resource Preservation	-			
30	Planning, Engineering and Design (20%)	$78,824,000	40%	$31,529,600	$110,353,600
31	Construction Management (9%)	$35,471,000	40%	$14,188,400	$49,659,400
	TOTAL	$529,858,200		$208,726,200	$738,584,400

Table B:6-2. Measure 8- Ring Levee 2 Cost Estimate (table indicates "Alternative 2," the data shown is correct for Measure 8, Ring Levee 2)

Alternative 2 - Ring Levee 2

Updated 14-Jan-20

Estimate of Probable Cost for Alternate 2

WBS	DESCRIPTION	COST	Con ingency	Contingency Cost	TOTAL COST
01	Lands and Damges	$7,532,800	25%	$1,883,200	$9,416,000
02	Relocations	$18,343,000	42%	$7,704,060	$26,047,060
06	Fish and Wildlife Facilities	$19,450,000	42%	$8,169,000	$27,619,000
11	Levees and Floodwalls	$438,888,000	42%	$184,332,960	$623,220,960
15	Floodway Control & Diversion Structure	$87,750,000	42%	$36,855,000	$124,605,000
18	Cultural Resource Preservation	$520,000	42%	$218,400	$738,400
30	Planning, Engineering and Design (20%)	$112,991,000	42%	$47,456,220	$160,447,220
31	Construction Management (9%)	$50,846,000	42%	$21,355,320	$72,201,320
	TOTAL	$736,320,800		$307,974,160	$1,044,294,960

Table B:6-3. Measure 9- Ring Levee 3 Cost Estimates (table indicates "Alternative 3," the data shown is correct for Measure 9, Ring Levee 3)

Alternative 3 - Ring Levee 3

Updated 14-Jan-20

Estimate of Probable Cost for Alternate 3

WBS	DESCRIPTION	COST	Con ingency	Contingency Cost	TOTAL COST
01	Lands and Damges	$1,720,800	25%	$430,200	$2,151,000
02	Relocations	$21,536,000	46%	$9,906,560	$31,442,560
06	Fish and Wildlife Facilities	-			
11	Levees and Floodwalls	$128,429,000	46%	$59,077,340	$187,506,340
15	Floodway Control & Diversion Structure	$137,750,000	46%	$63,365,000	$201,115,000
18	Cultural Resource Preservation	-			
30	Planning, Engineering and Design (20%)	$57,543,000	46%	$26,469,780	$84,012,780
31	Construction Management (9%)	$25,895,000	46%	$11,911,700	$37,806,700
	TOTAL	$372,873,800		$171,160,580	$544,034,380

Table B:6-4. Measure 8 var. Ring Levee 1+2 Cost Estimate (table indicates "Alternative 4," the data shown is correct for Measure 8 var., Ring Levee 1+2)

Alternative 4 - Ring Levee 1 + 2

Updated 14-Jan-20

Estimate of Probable Cost for Alternate 4

WBS	DESCRIPTION	COST	Contingency	Contingency Cost	TOTAL COST
01	Lands and Damges	$26,836,800	25%	$6,709,200	$33,546,000
02	Relocations	$25,319,000	38%	$9,621,220	$34,940,220
06	Fish and Wildlife Facilities	$16,309,000	38%	$6,197,420	$22,506,420
11	Levees and Floodwalls	$709,342,000	38%	$269,549,960	$978,891,960
15	Floodway Control & Diversion Structure	$125,000,000	38%	$47,500,000	$172,500,000
18	Cultural Resource Preservation	$114,675,000	38%	$43,576,500	$158,251,500
30	Planning, Engineering and Design (20%)	$198,129,000	38%	$75,289,020	$273,418,020
31	Construction Management (9%)	$89,159,000	38%	$33,880,420	$123,039,420
	TOTAL	$1,304,769,800		$492,323,740	$1,797,093,540

Table B:6-5. Measure 5- Levees West of Berwick Cost Estimate (table indicates "Alternative 5," the data shown is correct for Measure 5, Levees West of Berwick)

Alternative 5 - Ex-1, Berwick Levee Raises

Updated 14-Jan-20

Estimate of Probable Cost for Alternate 5

WBS	DESCRIPTION	COST	Contingency	Contingency Cost	TOTAL COST
01	Lands and Damges	$1,248,000	25%	$312,000	$1,560,000
02	Relocations	$3,324,000	38%	$1,263,120	$4,587,120
06	Fish and Wildlife Facilities	$923,000	38%	$350,740	$1,273,740
11	Levees and Floodwalls	$105,903,000	38%	$40,243,140	$146,146,140
18	Cultural Resource Preservation	$100,000	38%	$38,000	$138,000
30	Planning, Engineering and Design (20%)	$20,192,000	38%	$7,672,960	$27,864,960
31	Construction Management (9%)	$9,087,000	38%	$3,453,060	$12,540,060
	TOTAL	$140,777,000		$53,333,020	$194,110,020

Table B:6-6. Measure 6- Morgan City Cost Estimate (table indicates "Alternative 6," the data shown is correct for Measure 6, Morgan City Levee)

Alternative 6 - Ex-1, Morgan City Levee Raise

Updated 14-Jan-20

Estimate of Probable Cost for Alternate 2

WBS	DESCRIPTION	COST	Contingency	Contingency Cost	TOTAL COST
01	Lands and Damges	$672,800	25%	$168,200	$841,000
02	Relocations	-			
06	Fish and Wildlife Facilities	-			
11	Levees and Floodwalls	$32,515,000	45%	$14,631,750	$47,146,750
15	Floodway Control & Diversion Structure	$30,000,000	45%	$13,500,000	$43,500,000
18	Cultural Resource Preservation	$195,000	45%	$87,750	$282,750
30	Planning, Engineering and Design (20%)	$12,542,000	45%	$5,643,900	$18,185,900
31	Construction Management (9%)	$5,644,000	45%	$2,539,800	$8,183,800
	TOTAL	$81,568,800			$118,140,200

Table B:6-7. PRA/B-1 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-1								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	Reach Characteristics							
0.1	Reach Name	PrA/B-1						
0.2	Parish	Iberia						
0.3	Updated Reach Length	31,229	ft.					
0.4	Conversion factor	43,560	ft²/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	Planning, Engineering, Design, Permitting, and Construction Management							Sum PED, Perm., and CM
1.1	Planning, Engineering, and Design			6.5%	$18,106,122	$4,526,530	$22,632,652	$43,524,331
1.2	Permitting			1.0%	$2,785,557	$696,389	$3,481,946	
1.3	Construction Management			5.0%	$13,927,786	$3,481,946	$17,409,732	
2	Levee Construction							Sum First Lift
	Width: Total + ROW (Incl. Borrow Canal)	395	ft.					$25,649,803
	Width: Levee Surface	133	ft.					
	Height	19.0	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
2.2	Clearing & Grubbing	283	Ac	$4,293	$1,215,815	$303,954	$1,519,769	
2.3	Local Borrow Fill	1,390,860	CY	$14	$18,934,249	$4,733,562	$23,667,811	
2.4	Fertilize, Seed & Mulch	95	Ac	$3,875	$369,778	$92,445	$462,223	
3	Drainage Structures							Sum Drainage Structures
3.1	Total 10'X10' Box with Sluice Drainage Structures	3	EA	$2,263,115	$6,789,346	$1,697,337	$8,486,683	$8,486,683
4	T-Walls							Sum Walls
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	$0
5	2-Lane Highway Gates							Sum Hwy Gates
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	$0
6	Railroad Gates							Sum RR Gates
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	Pipeline/Utility Crossings							Sum Crossings
7.1	Total Crossings	7	LS	$211,530	$1,480,713	$370,178	$1,850,891	$1,850,891
8	Pump Station Frontal Protection							Sum Frontal Protection
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	$0
9	New Pump Stations							Sum New PS's
9.1	Total Capacity	11,050	CFS	$15,812	$174,727,851	$43,681,963	$218,409,814	$218,409,814
10	Navigation Gates							Sum Nav. Gates
10.1	30' Barge Gates	2	LS	$11,100,108	$22,200,216	$5,550,054	$27,750,270	$62,027,089
10.2	110' Barge Gates	1	LS	$27,421,455	$27,421,455	$6,855,364	$34,276,819	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	Real Estate							Sum ROW
11.1	Right-of-Way (Total Levee Footprint)	283	Ac	$5,000	$1,415,900	$353,975	$1,769,875	$3,063,677
11.2	Title Research and Legal Proceedings	5 9	Mi	$175,000	$1,035,042	$258,760	$1,293,802	
12	Mitigation Acreages							Sum Mitigation
12.1	Forested Wetlands	57	Ac	$232,474	$13,309,615	$3,327,404	$16,637,018	$28,706,693
12.2	Emergent Wetlands	114	Ac	$84,403	$9,655,740	$2,413,935	$12,069,674	

Itemized Cost Summary PrA/B-1								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	214	ft.					**$4,765,547**
	Width: Levee Surface	137	ft.					
	Height	19.5	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	252,145	CY	$14	$3,432,541	$858,135	$4,290,677	
13.2	Fertilize, Seed & Mulch	98	Ac	$3,875	$379,897	$94,974	$474,871	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	215	ft.					**$1,527,960**
	Width: Levee Surface	148	ft.					
	Height	21.0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	59,656	CY	$14	$812,116	$203,029	$1,015,146	
14.2	Fertilize, Seed & Mulch	106	Ac	$3,875	$410,252	$102,563	$512,815	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	283	Ac/yr	$157	$2,224,052	$556,013	$2,780,065	**$35,295,004**
15.2	Gate Maintenance	3	EA/yr	$73,303	$10,995,390.00	$2,748,848	$13,744,238	
15.3	Pump Station Maintenance	3	EA/yr	$100,110	$15,016,561.20	$3,754,140	$18,770,702	
	Total Cost				**$346,645,994**	**$86,661,499**	**$433,307,493**	**$433,307,493**

Table B:6-8. PRA/B-2 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-2								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	PrA/B-2						
0.2	Parish	beria						
0.3	Updated Reach Length	13,993	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$2,555,742	$638,936	$3,194,678	**$6,143,611**
1.2	Permitting			1.0%	$393,191	$98,298	$491,489	
1.3	Construction Management			5.0%	$1,965,956	$491,489	$2,457,444	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	349	ft.					**$8,330,859**
	Width: Levee Surface	111	ft.					
	Height	16.5	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
2.2	Clearing & Grubbing	112	Ac	$4,293	$480,659	$120,165	$600,824	
2.3	Local Borrow Fill	444,089	CY	$14	$6,045,538	$1,511,385	$7,556,923	
2.4	Fertilize, Seed & Mulch	36	Ac	$3,875	$138,490	$34,622	$173,112	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	9	EA	$2,263,115	$20,368,038	$5,092,010	$25,460,048	**$25,460,048**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	6	LS	$211,530	$1,269,182	$317,296	$1,586,478	**$1,586,478**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	112	Ac	$5,000	$559,760	$139,940	$699,700	**$1,279,438**
11 2	Title Research and Legal Proceedings	2.7	Mi	$175,000	$463,790	$115,948	$579,738	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	15	Ac	$232,474	$3,424,668	$856,167	$4,280,835	**$4,769,115**
12 2	Emergent Wetlands	5	Ac	$84,403	$390,624	$97,656	$488,280	

Itemized Cost Summary PrA/B-2								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	188	ft.					**$664,538**
	Width: Levee Surface	114	ft.					
	Height	16 9	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	28,613	CY	$14	$389,513	$97,378	$486,892	
13 2	Fertilize, Seed & Mulch	37	Ac	$3,875	$142,117	$35,529	$177,646	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	189	ft.					**$1,740,218**
	Width: Levee Surface	122	ft.					
	Height	18 0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	91,093	CY	$14	$1,240,083	$310,021	$1,550,104	
14 2	Fertilize, Seed & Mulch	39	Ac	$3,875	$152,092	$38,023	$190,114	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	112	Ac/yr	$157	$879,254	$219,813	$1,099,067	**$5,680,480**
15 2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15 3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$50,702,189**	**$12,675,547**	**$63,377,737**	**$63,377,737**

Table B:6-9. PRA/B-3 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-3								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	PrA/B-3						
0.2	Parish	beria						
0.3	Updated Reach Length	32,810	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$13,803,237	$3,450,809	$17,254,046	$33,180,858
1.2	Permitting			1.0%	$2,123,575	$530,894	$2,654,469	
1.3	Construction Management			5.0%	$10,617,875	$2,654,469	$13,272,343	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	334	ft.					$17,775,843
	Width: Levee Surface	103	ft.					
	Height	15.5	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	252	Ac	$4,293	$1,080,112	$270,028	$1,350,140	
2.3	Local Borrow Fill	943,136	CY	$14	$12,839,233	$3,209,808	$16,049,041	
2.4	Fertilize, Seed & Mulch	78	Ac	$3,875	$301,330	$75,333	$376,663	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	12	EA	$2,263,115	$27,157,385	$6,789,346	$33,946,731	$33,946,731
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	$0
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	$7,722,953
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	10	LS	$211,530	$2,115,304	$528,826	$2,644,130	$2,644,130
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	$0
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	5,200	CFS	$15,812	$82,224,574	$20,556,143	$102,780,717	$102,780,717
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	1	LS	$11,100,108	$11,100,108	$2,775,027	$13,875,135	$75,573,410
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	1	LS	$49,358,620	$49,358,620	$12,339,655	$61,698,275	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	252	Ac	$5,000	$1,257,864	$314,466	$1,572,330	$2,931,643
11 2	Title Research and Legal Proceedings	6 2	Mi	$175,000	$1,087,451	$271,863	$1,359,313	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	72	Ac	$232,474	$16,691,054	$4,172,763	$20,863,817	$22,071,439
12 2	Emergent Wetlands	11	Ac	$84,403	$966,097	$241,524	$1,207,621	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	182	ft.					$1,440,871
	Width: Levee Surface	107	ft.					
	Height	16.0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary PrA/B-3								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	61,758	CY	$14	$840,736	$210,184	$1,050,920	
13 2	Fertilize, Seed & Mulch	81	Ac	$3,875	$311,961	$77,990	$389,951	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	184	ft.					**$3,801,543**
	Width: Levee Surface	118	ft.					
	Height	17 5	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	198,143	CY	$14	$2,697,382	$674,345	$3,371,727	
14 2	Fertilize, Seed & Mulch	89	Ac	$3,875	$343,853	$85,963	$429,816	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	252	Ac/yr	$157	$1,975,814	$493,954	$2,469,768	**$22,470,906**
15 2	Gate Maintenance	3	EA/yr	$73,303	$10,995,390.00	$2,748,848	$13,744,238	
15 3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$261,072,834**	**$65,268,208**	**$326,341,042**	**$326,341,042**

Table B:6-10. PRA/B-4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-4								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA/B-4						
0.2	Parish	beria						
0.3	Updated Reach Length	25,629	ft.					
0.4	Conversion factor	43,560	ft²/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6 5%	$8,122,850	$2,030,713	$10,153,563	$19,526,082
1.2	Permitting			1 0%	$1,249,669	$312,417	$1,562,087	
1.3	Construction Management			5 0%	$6,248,346	$1,562,087	$7,810,433	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	341	ft.					$13,359,511
	Width: Levee Surface	100	ft.					
	Height	14.7	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	201	Ac	$4,293	$861,410	$215,352	$1,076,762	
2.3	Local Borrow Fill	705,126	CY	$14	$9,599,120	$2,399,780	$11,998,900	
2.4	Fertilize, Seed & Mulch	59	Ac	$3,875	$227,079	$56,770	$283,849	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	17	EA	$2,263,115	$38,472,961	$9,618,240	$48,091,202	$48,091,202
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8 377	$0	$0	$0	$0
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	$0
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	2	LS	$211,530	$423,061	$105,765	$528,826	$528,826
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	$0
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	2,419	CFS	$15,812	$38,252,769	$9,563,192	$47,815,961	$47,815,961
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	2	LS	$11,100,108	$22,200,216	$5,550,054	$27,750,270	$27,750,270
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	201	Ac	$5,000	$1,003,170	$250,793	$1,253,963	$2,315,788
11 2	Title Research and Legal Proceedings	4.9	Mi	$175,000	$849,460	$212,365	$1,061,824	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	42	Ac	$232,474	$9,712,032	$2,428,008	$12,140,040	$16,347,096
12 2	Emergent Wetlands	40	Ac	$84,403	$3,365,645	$841,411	$4,207,056	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	186	ft.					$1,916,487
	Width: Levee Surface	106	ft.					

Itemized Cost Summary PrA/B-4								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
	Height	15 6	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
13.1	Opposite Cast	94,845	CY	$14	$1,291,163	$322,791	$1,613,953	
13 2	Fertilize, Seed & Mulch	62	Ac	$3,875	$242,027	$60,507	$302,533	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	186	ft.					**$2,959,610**
	Width: Levee Surface	116	ft.					
	Height	17 0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
14.1	Opposite Cast	154,437	CY	$14	$2,102,410	$525,602	$2,628,012	
14 2	Fertilize, Seed & Mulch	68	Ac	$3,875	$265,278	$66,320	$331,598	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	201	Ac/yr	$157	$1,575,750	$393,937	$1,969,687	**$17,389,412**
15 2	Gate Maintenance	2	EA/yr	$73,303	$7,330,260 00	$1,832,565	$9,162,825	
15 3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$158,400,196**	**$39,600,049**	**$198,000,245**	**$198,000,245**

Table B:6-11. PRA-4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA-4								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	PrA-4						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	56,907	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$5,279,613	$1,319,903	$6,599,517	**$12,691,378**
1.2	Permitting			1.0%	$812,248	$203,062	$1,015,310	
1.3	Construction Management			5.0%	$4,061,241	$1,015,310	$5,076,551	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	333	ft.					**$24,311,672**
	Width: Levee Surface	92	ft.					
	Height	13.5	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	434	Ac	$4,293	$1,864,985	$466,246	$2,331,232	
2.3	Local Borrow Fill	1,257,372	CY	$14	$17,117,026	$4,279,257	$21,396,283	
2.4	Fertilize, Seed & Mulch	121	Ac	$3,875	$467,326	$116,832	$584,158	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	8	EA	$2,263,115	$18,104,923	$4,526,231	$22,631,154	**$22,631,154**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	1	LS	$4,921,746	$4,921,746	$1,230,437	$6,152,183	**$6,152,183**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	12	LS	$211,530	$2,538,364	$634,591	$3,172,955	**$3,172,955**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	790	CFS	$15,812	$12,491,810	$3,122,953	$15,614,763	**$15,614,763**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	434	Ac	$5,000	$2,171,903	$542,976	$2,714,879	**$5,072,538**
11 2	Title Research and Legal Proceedings	10.8	Mi	$175,000	$1,886,128	$471,532	$2,357,660	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	51	Ac	$232,474	$11,921,495	$2,980,374	$14,901,869	**$16,852,810**
12 2	Emergent Wetlands	18	Ac	$84,403	$1,560,753	$390,188	$1,950,941	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	179	ft.					**$3,895,375**
	Width: Levee Surface	100	ft.					
	Height	14.5	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary PrA-4								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	191,878	CY	$14	$2,612,097	$653,024	$3,265,121	
13 2	Fertilize, Seed & Mulch	130	Ac	$3,875	$504,203	$126,051	$630,254	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	183	ft.					**$8,011,097**
	Width: Levee Surface	114	ft.					
	Height	16 5	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	428,324	CY	$14	$5,830,921	$1,457,730	$7,288,651	
14 2	Fertilize, Seed & Mulch	149	Ac	$3,875	$577,957	$144,489	$722,446	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	434	Ac/yr	$157	$3,411,559	$852,890	$4,264,448	**$19,684,174**
15 2	Gate Maintenance	2	EA/yr	$73,303	$7,330,260.00	$1,832,565	$9,162,825	
15 3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$116,650,441**	**$29,162,610**	**$145,813,051**	**$145,813,051**

Table B:6-12. PRA-5 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA-5								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	PrA-5						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	29,791	ft.					
0.4	Conversion factor	43,560	ft²/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1 05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6 5%	$3,134,924	$783,731	$3,918,655	**$7,535,876**
1.2	Permitting			1 0%	$482,296	$120,574	$602,870	
1.3	Construction Management			5 0%	$2,411,480	$602,870	$3,014,350	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	365	ft.					**$18,851,051**
	Width: Levee Surface	111	ft.					
	Height	16.0	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	249	Ac	$4,293	$1,070,286	$267,572	$1,337,858	
2.3	Local Borrow Fill	1,007,662	CY	$14	$13,717,645	$3,429,411	$17,147,056	
2.4	Fertilize, Seed & Mulch	76	Ac	$3,875	$292,909	$73,227	$366,137	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	3	EA	$2,263,115	$6,789,346	$1,697,337	$8,486,683	**$8,486,683**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	5	LS	$211,530	$1,057,652	$264,413	$1,322,065	**$1,322,065**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	249	Ac	$5,000	$1,246,421	$311,605	$1,558,027	**$2,792,267**
11 2	Title Research and Legal Proceedings	5.6	Mi	$175,000	$987,392	$246,848	$1,234,240	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	52	Ac	$232,474	$12,099,213	$3,024,803	$15,124,016	**$21,111,987**
12 2	Emergent Wetlands	57	Ac	$84,403	$4,790,377	$1,197,594	$5,987,971	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	199	ft.					**$1,412,194**
	Width: Levee Surface	114	ft.					
	Height	16.5	ft.					

Itemized Cost Summary PrA-5								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	60,763	CY	$14	$827,193	$206,798	$1,033,992	
13 2	Fertilize, Seed & Mulch	78	Ac	$3,875	$302,562	$75,640	$378,202	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	200	ft.					**$3,679,965**
	Width: Levee Surface	125	ft.					
	Height	18.0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	191,904	CY	$14	$2,612,452	$653,113	$3,265,565	
14 2	Fertilize, Seed & Mulch	86	Ac	$3,875	$331,519	$82,880	$414,399	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	249	Ac/yr	$157	$1,957,841	$489,460	$2,447,301	**$7,028,713**
15 2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15 3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$63,955,002**	**$15,988,750**	**$79,943,752**	**$79,943,752**

Table B:6-13. PRA-6 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA-6								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	PrA-6						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	57,051	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$14,305,602	$3,576,401	$17,882,003	$34,388,467
1.2	Permitting			1.0%	$2,200,862	$550,215	$2,751,077	
1.3	Construction Management			5.0%	$11,004,309	$2,751,077	$13,755,387	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	337	ft.					$24,185,570
	Width: Levee Surface	90	ft.					
	Height	13.2	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
2.2	Clearing & Grubbing	441	Ac	$4,293	$1,895,006	$473,751	$2,368,757	
2.3	Local Borrow Fill	1,248,484	CY	$14	$16,996,034	$4,249,008	$21,245,042	
2.4	Fertilize, Seed & Mulch	118	Ac	$3,875	$457,417	$114,354	$571,771	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	16	EA	$2,263,115	$36,209,846	$9,052,462	$45,262,308	$45,262,308
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	$0
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	$0
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	2	LS	$4,921,746	$9,843,492	$2,460,873	$12,304,365	$12,304,365
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	13	LS	$211,530	$2,749,895	$687,474	$3,437,368	$3,437,368
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	$0
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	6,442	CFS	$15,812	$101,865,178	$25,466,294	$127,331,472	$127,331,472
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	1	LS	$11,100,108	$11,100,108	$2,775,027	$13,875,135	$48,151,954
10 2	110' Barge Gates	1	LS	$27,421,455	$27,421,455	$6,855,364	$34,276,819	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	441	Ac	$5,000	$2,206,863	$551,716	$2,758,579	$5,122,201
11 2	Title Research and Legal Proceedings	10.8	Mi	$175,000	$1,890,897	$472,724	$2,363,621	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	27	Ac	$232,474	$6,234,529	$1,558,632	$7,793,161	$9,312,497
12 2	Emergent Wetlands	14	Ac	$84,403	$1,215,469	$303,867	$1,519,336	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft.					$5,489,142
	Width: Levee Surface	92	ft.					
	Height	13.4	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						

Itemized Cost Summary PrA-6								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	288,430	CY	$14	$3,926,502	$981,626	$4,908,128	
13 2	Fertilize, Seed & Mulch	120	Ac	$3,875	$464,811	$116,203	$581,014	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft.					**$4,235,720**
	Width: Levee Surface	103	ft.					
	Height	15 0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	210,427	CY	$14	$2,864,613	$716,153	$3,580,766	
14 2	Fertilize, Seed & Mulch	135	Ac	$3,875	$523,963	$130,991	$654,954	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	441	Ac/yr	$157	$3,466,474	$866,618	$4,333,092	**$35,172,543**
15 2	Gate Maintenance	4	EA/yr	$73,303	$14,660,520.00	$3,665,130	$18,325,650	
15 3	Pump Station Maintenance	2	EA/yr	$100,110	$10,011,040.80	$2,502,760	$12,513,801	
	Total Cost				**$283,514,885**	**$70,878,721**	**$354,393,607**	**$354,393,607**

Table B:6-14. PRB-4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrB-4								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	PrB-4						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	25,707	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$2,537,177	$634,294	$3,171,471	$6,098,983
1.2	Permitting			1.0%	$390,335	$97,584	$487,919	
1.3	Construction Management			5.0%	$1,951,675	$487,919	$2,439,593	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	341	ft.					$13,400,129
	Width: Levee Surface	100	ft.					
	Height	14.7	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	201	Ac	$4,293	$864,029	$216,007	$1,080,036	
2.3	Local Borrow Fill	707,270	CY	$14	$9,628,305	$2,407,076	$12,035,381	
2.4	Fertilize, Seed & Mulch	59	Ac	$3,875	$227,770	$56,942	$284,712	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	6	EA	$2,263,115	$13,578,692	$3,394,673	$16,973,365	$16,973,365
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	$0
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	$7,722,953
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	6	LS	$211,530	$1,269,182	$317,296	$1,586,478	$1,586,478
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	$0
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	90	CFS	$15,812	$1,428,652	$357,163	$1,785,815	$1,785,815
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	$0
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	201	Ac	$5,000	$1,006,221	$251,555	$1,257,776	$2,322,829
11 2	Title Research and Legal Proceedings	4 9	Mi	$175,000	$852,042	$213,011	$1,065,053	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	14	Ac	$232,474	$3,208,525	$802,131	$4,010,656	$5,000,295
12 2	Emergent Wetlands	9	Ac	$84,403	$791,711	$197,928	$989,639	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	186	ft.					$1,922,314
	Width: Levee Surface	106	ft.					
	Height	15.6	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary PrB-4								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	95,134	CY	$14	$1,295,088	$323,772	$1,618,861	
13 2	Fertilize, Seed & Mulch	63	Ac	$3,875	$242,762	$60,691	$303,453	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	186	ft.					**$2,968,609**
	Width: Levee Surface	116	ft.					
	Height	17 0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	154,907	CY	$14	$2,108,802	$527,201	$2,636,003	
14 2	Fertilize, Seed & Mulch	69	Ac	$3,875	$266,085	$66,521	$332,606	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	201	Ac/yr	$157	$1,580,540	$395,135	$1,975,676	**$12,813,989**
15 2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15 3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$58,076,606**	**$14,519,151**	**$72,595,757**	**$72,595,757**

Table B:6-15. PRB-5 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrB-5								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	PrB-5						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	38,640	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$13,217,813	$3,304,453	$16,522,266	**$31,773,589**
1.2	Permitting			1.0%	$2,033,510	$508,377	$2,541,887	
1.3	Construction Management			5.0%	$10,167,548	$2,541,887	$12,709,436	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	322	ft.					**$16,677,711**
	Width: Levee Surface	90	ft.					
	Height	13.2	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	286	Ac	$4,293	$1,226,337	$306,584	$1,532,921	
2.3	Local Borrow Fill	867,240	CY	$14	$11,806,029	$2,951,507	$14,757,536	
2.4	Fertilize, Seed & Mulch	80	Ac	$3,875	$309,803	$77,451	$387,254	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	16	EA	$2,263,115	$36,209,846	$9,052,462	$45,262,308	**$45,262,308**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	1	LS	$4,921,746	$4,921,746	$1,230,437	$6,152,183	**$6,152,183**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	8	LS	$211,530	$1,692,243	$423,061	$2,115,304	**$2,115,304**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	6,442	CFS	$15,812	$101,865,178	$25,466,294	$127,331,472	**$127,331,472**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	1	LS	$11,100,108	$11,100,108	$2,775,027	$13,875,135	**$48,151,954**
10 2	110' Barge Gates	1	LS	$27,421,455	$27,421,455	$6,855,364	$34,276,819	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	286	Ac	$5,000	$1,428,153	$357,038	$1,785,191	**$3,386,043**
11 2	Title Research and Legal Proceedings	7 3	Mi	$175,000	$1,280,682	$320,170	$1,600,852	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	13	Ac	$232,474	$3,069,233	$767,308	$3,836,541	**$5,111,737**
12 2	Emergent Wetlands	12	Ac	$84,403	$1,020,157	$255,039	$1,275,196	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft.					**$3,735,379**
	Width: Levee Surface	92	ft.					
	Height	13.4	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary PrB-5								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	196,388	CY	$14	$2,673,492	$668,373	$3,341,865	
13 2	Fertilize, Seed & Mulch	81	Ac	$3,875	$314,811	$78,703	$393,513	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft.					**$2,877,073**
	Width: Levee Surface	103	ft.					
	Height	15 0	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	143,006	CY	$14	$1,946,785	$486,696	$2,433,481	
14 2	Fertilize, Seed & Mulch	92	Ac	$3,875	$354,874	$88,718	$443,592	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	286	Ac/yr	$157	$2,243,299	$560,825	$2,804,124	**$29,062,162**
15 2	Gate Maintenance	3	EA/yr	$73,303	$10,995,390.00	$2,748,848	$13,744,238	
15 3	Pump Station Maintenance	2	EA/yr	$100,110	$10,011,040.80	$2,502,760	$12,513,801	
	Total Cost				**$257,309,531**	**$64,327,383**	**$321,636,914**	**$321,636,914**

Table B:6-16. EX2 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-2								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	Ex-2						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	30,320	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$2,315,098	$578,775	$2,893,873	$5,565,140
1.2	Permitting			1.0%	$356,169	$89,042	$445,211	
1.3	Construction Management			5.0%	$1,780,845	$445,211	$2,226,056	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	101	ft.					$15,143,623
	Width: Levee Surface	105	ft.					
	Height	13.0	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	418,496	CY	$28	$11,832,502	$2,958,126	$14,790,628	
2.4	Fertilize, Seed & Mulch	73	Ac	$3,875	$282,396	$70,599	$352,995	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	$0
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	$0
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	$0
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	$0
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	850	LF	$25,132	$21,362,472	$5,340,618	$26,703,090	$26,703,090
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	$0
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	$0
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	70	Ac	$5,000	$351,511	$87,878	$439,389	$1,695,563
11 2	Title Research and Legal Proceedings	5.7	Mi	$175,000	$1,004,940	$251,235	$1,256,175	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	3	Ac	$232,474	$605,201	$151,300	$756,501	$978,843
12 2	Emergent Wetlands	2	Ac	$84,403	$177,873	$44,468	$222,342	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary Ex-2								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	70	Ac/yr	$157	$552,143	$138,036	$690,179	$690,179
15 2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15 3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$40,621,150**	**$10,155,288**	**$50,776,438**	**$50,776,438**

Table B:6-17. EX3 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-3								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	Ex-3						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	30,772	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,477,168	$369,292	$1,846,460	$3,550,884
1.2	Permitting			1.0%	$227,257	$56,814	$284,071	
1.3	Construction Management			5.0%	$1,136,283	$284,071	$1,420,354	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	115	ft.					$17,519,254
	Width: Levee Surface	119	ft.					
	Height	15.0	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	484,155	CY	$28	$13,688,921	$3,422,230	$17,111,152	
2.4	Fertilize, Seed & Mulch	84	Ac	$3,875	$326,482	$81,620	$408,102	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	$0
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	$0
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	$0
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	$0
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	250	LF	$25,132	$6,283,080	$1,570,770	$7,853,850	$7,853,850
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	$0
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	$0
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	81	Ac	$5,000	$406,194	$101,548	$507,742	$1,782,618
11 2	Title Research and Legal Proceedings	5 8	Mi	$175,000	$1,019,901	$254,975	$1,274,876	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	4	Ac	$232,474	$898,195	$224,549	$1,122,744	$1,251,353
12 2	Emergent Wetlands	1	Ac	$84,403	$102,888	$25,722	$128,609	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary Ex-3								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	81	Ac/yr	$157	$638,037	$159,509	$797,546	$797,546
15 2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15 3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$26,204,404**	**$6,551,101**	**$32,755,505**	**$32,755,505**

Table B:6-18. EX4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-4								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	Ex-4						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	17,368	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,678,605	$419,651	$2,098,257	**$4,035,109**
1.2	Permitting			1.0%	$258,247	$64,562	$322,809	
1.3	Construction Management			5.0%	$1,291,235	$322,809	$1,614,044	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	143	ft.					**$22,586,055**
	Width: Levee Surface	148	ft.					
	Height	19.0	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	630,956	CY	$28	$17,839,556	$4,459,889	$22,299,445	
2.4	Fertilize, Seed & Mulch	59	Ac	$3,875	$229,288	$57,322	$286,610	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	250	LF	$25,132	$6,283,080	$1,570,770	$7,853,850	**$7,853,850**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	57	Ac	$5,000	$285,079	$71,270	$356,348	**$1,075,898**
11 2	Title Research and Legal Proceedings	3 3	Mi	$175,000	$575,640	$143,910	$719,550	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	2	Ac	$232,474	$528,350	$132,087	$660,437	**$765,069**
12 2	Emergent Wetlands	1	Ac	$84,403	$83,705	$20,926	$104,631	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					**$0**
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary Ex-4								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	57	Ac/yr	$157	$447,793	$111,948	$559,741	$559,741
15 2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15 3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$29,500,577**	**$7,375,144**	**$36,875,722**	**$36,875,722**

Table B:6-19. EX5 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-5								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	Ex-5						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	19,701	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,611,822	$402,956	$2,014,778	$3,874,573
1.2	Permitting			1.0%	$247,973	$61,993	$309,966	
1.3	Construction Management			5.0%	$1,239,863	$309,966	$1,549,829	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	133	ft.					$21,641,900
	Width: Levee Surface	137	ft.					
	Height	17.5	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	603,829	CY	$28	$17,072,580	$4,268,145	$21,340,724	
2.4	Fertilize, Seed & Mulch	62	Ac	$3,875	$240,940	$60,235	$301,176	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	$0
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	$0
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	$7,722,953
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	$0
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	$0
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	$0
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	$0
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	60	Ac	$5,000	$299,632	$74,908	$374,540	$1,190,755
11 2	Title Research and Legal Proceedings	3.7	Mi	$175,000	$652,972	$163,243	$816,215	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	0	Ac	$232,474	$52,835	$13,209	$66,044	$440,973
12 2	Emergent Wetlands	4	Ac	$84,403	$299,944	$74,986	$374,929	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary Ex-5								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	60	Ac/yr	$157	$470,653	$117,663	$588,316	$5,169,729
15 2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15 3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$32,032,706**	**$8,008,176**	**$40,040,882**	**$40,040,882**

Table B:6-20. EX6 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-6								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
0	**Reach Characteristics**							
0.1	Reach Name	Ex-6						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	27,555	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$656,260	$164,065	$820,325	**$1,577,549**
1.2	Permitting			1.0%	$100,963	$25,241	$126,204	
1.3	Construction Management			5.0%	$504,816	$126,204	$631,019	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	112	ft.					**$10,360,241**
	Width: Levee Surface	116	ft.					
	Height	14.5	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	283,116	CY	$28	$8,004,770	$2,001,193	$10,005,963	
2.4	Fertilize, Seed & Mulch	73	Ac	$3,875	$283,423	$70,856	$354,278	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10 2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10 3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	71	Ac	$5,000	$352,660	$88,165	$440,824	**$1,582,422**
11 2	Title Research and Legal Proceedings	5 2	Mi	$175,000	$913,278	$228,320	$1,141,598	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	2	Ac	$232,474	$451,499	$112,875	$564,374	**$677,725**
12 2	Emergent Wetlands	1	Ac	$84,403	$90,681	$22,670	$113,351	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					**$0**
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						

Itemized Cost Summary Ex-6								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14 2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	71	Ac/yr	$157	$553,947	$138,487	$692,434	$692,434
15 2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15 3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$11,912,296**	**$2,978,074**	**$14,890,370**	**$14,890,370**

Table B:6-21. EX7 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-7								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	Ex-7						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	30,937	ft.					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1 05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,521,306	$380,327	$1,901,633	$3,656,987
1.2	Permitting			1.0%	$234,047	$58,512	$292,559	
1.3	Construction Management			5.0%	$1,170,236	$292,559	$1,462,795	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	105	ft.					$6,157,009
	Width: Levee Surface	108	ft.					
	Height	13 5	ft.					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demob*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	163,665	CY	$28	$4,627,448	$1,156,862	$5,784,310	
2.4	Fertilize, Seed & Mulch	77	Ac	$3,875	$298,159	$74,540	$372,699	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	$0
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	800	LF	$8,377	$6,701,952	$1,675,488	$8,377,440	$8,377,440
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	$0
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	$0
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	$0
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	400	LF	$25,132	$10,052,928	$2,513,232	$12,566,160	$12,566,160
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	$0
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	$0
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	74	Ac	$5,000	$371,083	$92,771	$463,854	$1,745,558
11.2	Title Research and Legal Proceedings	5.9	Mi	$175,000	$1,025,363	$256,341	$1,281,704	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	1	Ac	$232,474	$235,356	$58,839	$294,195	$409,725
12.2	Emergent Wetlands	1	Ac	$84,403	$92,424	$23,106	$115,531	

Itemized Cost Summary Ex-7								
Item No.	Item Description	Quantity	Unit	Unit Cost	Total	25% Contingency	Total with Contingency	Subtotals
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft.					$0
	Width: Levee Surface	N/A	ft.					
	Height	N/A	ft.					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	74	Ac/yr	$157	$582,887	$145,722	$728,608	$728,608
15.2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$26,913,190**	**$6,728,297**	**$33,641,487**	**$33,641,487**

6.4 NONSTRUCTURAL MEASURES: ELEVATION, FLOODPROOFING, AND ACQUISITION/RELOCATION

Nationally Significant Industries within the study area include oil and gas industry. While these assets are vital to the regional economy, it is expected that short-term disruptions of their productivity would be made up elsewhere in the nation over the long-run. Previous MVN projects have assessed the ability of other national centers to make up for temporary production loss locally and have shown this to be the case. Therefore, economic damages (project benefits) would be captured in the Regional Economic Development (RED) account. The regional significance to employment, production, and other factors has not been included in the economic appendix and would fall into the RED account. RED benefits will be further refined during feasibility level of design and incorporated into the final report.

It was determined through various sources that elevation of structures would not be feasible/recommended above 13 feet ground level. These sources included:

1. 1) 2008 Shoring company interviews - the shoring companies only provided costs up to 13 feet due to constructability and other constraints.
2. 2) FEMA P-550, pages 5-10, 5-11, which states you can elevate up to 10-15 feet (https://www.fema.gov/media-library-data/20130726-1517-20490-9361/fema_p550_rev3.pdf)
3. 3) FEMA P-762 Chapter 2, references 10-15 feet
4. 4) CPRA Master Plan, which states they support up to 14 feet
5. 5) St. Mary's Parish Unified Development Ordinance, which references a max structure height of 35 feet (GSE to roof top).
6. 6) International Building Code Chapter 5, references 2 story building with a 40' total height

Table B:6-22 provides average nonstructural acquisition/relocation cost estimates per building and Table B:6-23 provides average nonstructural elevation/commercial cost estimates per building. Additional information is contained in the Economics Appendix.

Table B:6-22. Nonstructural Acquisition/Relocation Average Cost Estimate Per Building

Residential Acquisiton/Relocation Cost		
Price Level:	2019	
Acquisition Costs		
Land Costs	2	sf
Acquisition Land Costs (Moving from)	$39,800	
Demolition, Deed, Legal, Regrading	$47,000	
Cultural Resources Arch Survey	$2 000	
Structure Value		
Total Acquisition Costs	$88,800	
Total Acquisition Costs w/ Contingency	$119,436	
Relocation Costs		
Relocation Costs	$38,000	
Relocation Land Value (Moving to)	$39,800	
Total Relocation Costs	$77 800	
Total Relocation Costs w/ Contingency	$104,641	

Non-Residential Acquisiton/Relocation Cost		
Price Level:	2019	
Acquisition Costs		
Land Costs	3	sf
Acquisition Land Costs (Moving from)	$300,000	
Demolition, Deed, Legal, Regrading	$141,000	
Cultural Resources Arch Survey	$2 000	
Structure Value		
Total Acquisition Costs	$443,000	
Total Acquisition Costs w/ Contingency	$595,835	
Relocation Costs		
Relocation Costs	$50,000	
Relocation Land Value (Moving to)	$300,000	
Total Relocation Costs	$350 000	
Total Relocation Costs w/ Contingency	$470,750	

*Land Costs include the cost of suitable land to relocate a new structure to and is computed for the entire parcel

*Average Land Costs for res computed by using the average parcel size for a 1,500 sq ft. house, which is 19,900 sq ft. lot

*Average Land Costs for non-res computed by using average parcel size for a COM structure, which is 100,000 sq ft. lot

*Relocation costs include moving costs and incidentals for residential structures. It includes Uniform Relocation Act

*Relocation costs include moving costs, searching expenses, and re-establishing costs for non-residential

*34.5% contingency added to depreciated replacement values

Sources:

Land Costs - MVN Real Estate Office

Land Value - MVN Real Estate Office

Cultural Survey - MVN Cultural Resources Office

Demo, et al - 2010 MVR Des Moines River Feas bility Study

Table B:6-22. Nonstructural Elevation/Commercial Average Cost Estimate Per Building

BASE COSTS (NO CONTINGENCY)

Residential Elevation Cost					
Source:	New Orleans District (2012 Donaldson to the Gulf Study)				
Price Level:	2019				
Height	1STY-PIER	1STY-SLAB	2STY-PIER	2STY-SLAB	MOBILE
[ft]	[$]	[$]	[$]	[$]	[$]
N/A	0	0	0	0	0
1	78	88	86	97	43
2	78	88	86	97	43
3	81	90	89	99	43
4	81	93	89	106	53
5	81	93	89	106	53
6	83	95	91	107	53
7	83	95	91	107	53
8	85	98	93	111	53
9	85	98	93	111	53
10	85	98	93	111	53
11	85	98	93	111	53
12	85	98	93	111	53
13	86	101	95	117	53
14	86	101	95	117	53
15	86	101	95	117	53
16	86	101	95	117	53

Commercial Floodproofing Cost	
Source: New Orleans District (2012 Donaldson to the Gulf St	
Price Level:	2019
Square Footage	Cost
1,000	113,759
10,000	113,759
20,000	113,759
30,000	268,800
40,000	268,800
50,000	268,800
60,000	268,800
70,000	268,800
80,000	268,800
90,000	268,800
100,000	268,800
110,000	664,476
120,000	664,476
130,000	664,476
140,000	664,476
150,000	664,476

PROJECT COSTS (WITH CONTINGENCY, 34.5%)

Residential Elevation Cost					
Source:	New Orleans District (2012 Donaldson to the Gulf Study)				
Price Level:	2019				
Height	1STY-PIER	1STY-SLAB	2STY-PIER	2STY-SLAB	MOBILE
[ft]	[$]	[$]	[$]	[$]	[$]
N/A	0	0	0	0	0
1	105	118	116	130	58
2	105	118	116	130	58
3	109	121	120	133	58
4	109	125	120	143	71
5	109	125	120	143	71
6	112	128	122	144	71
7	112	128	122	144	71
8	114	132	125	149	71
9	114	132	125	149	71
10	114	132	125	149	71
11	114	132	125	149	71
12	114	132	125	149	71
13	116	136	128	157	71
14	116	136	128	157	71
15	116	136	128	157	71
16	116	136	128	157	71

Commercial Floodproofing Cost	
Source: New Orleans District (2012 Donaldson to the Gulf St	
Price Level:	2019
Square Footage	Cost
1,000	153,006
10,000	153,006
20,000	153,006
30,000	361,536
40,000	361,536
50,000	361,536
60,000	361,536
70,000	361,536
80,000	361,536
90,000	361,536
100,000	361,536
110,000	893,720
120,000	893,720
130,000	893,720
140,000	893,720
150,000	893,720

Residential	W/O Conting	W/ Conting
Average Cost	$ 170,000	$ 228,650
Non-Residenti	W/O Conting	W/ Conting
Average Cost	$ 664,476	$ 893,720

*Costs were determined from the 2012 Donaldson to the Gulf Study and escalated to 2019 costs.

*34.5% contingency added to values

6.5 REFINED ALTERNATIVE 1 NONSTRUCTURAL MEASURES– RAISING, DRY FLOODPROOFING, WET FLOODPROOFING

The project cost consists of a National Economic Development NED (non-structural – structure raising and floodproofing) feature. The project cost estimates for the NED features were developed in MCACES MII cost estimating software and used the standard approaches for a feasibility estimate structure regarding labor, equipment, materials, crews, unit prices, quotes, sub- and prime contractor markups. This philosophy was taken wherever practical within the time constraints. The project partner is the local sponsor (LS), State of Louisiana CPRA. Cost estimates for wet floodproofing were prepared by Roderick Scott, CFM, and Gerald Gesser, Architect, members of the Flood Mitigation Industry Association due to limited USACE funds and time following 3x3x3 study guidance. Some costs were developed or supplemented with estimating information from other sources such as quotes, bid data, and A-E estimates. The intent was to provide or convey "fair and reasonable" estimates that depict the local market conditions. The estimates assume a typical application of subcontractors. Given the long time over which this project/program is to be constructed and the unknown economic status during that time, demands from non-governmental civil works projects were not considered to dampen the competition and increase prices.

6.5.1 Estimate Structure

The NED estimate was structured to develop the unit costs in Mii representing the standard type non-structural work being performed. The Mii unit cost for the average structure of each type were then applied to the voluminous quantities of structures to be raised or floodproofed in an Excel summary spreadsheet that was transferred to the TPCS.

All work activities and corresponding levels of effort are based upon wet-floodproofing square footage estimates developed the Flood Mitigation Industry Association (ASFPM), LLC in July and Aug 2020.

Structure elevations square footage estimates are based upon conversations with Davies Shoring, LLC and Orleans Shoring on 23 June 2015 and 24 June 2015, respectively.

Residential Elevation Projects were group according to these categories:

- Mobile Home, Low Lift - This includes manufactured homes raised a minimum of 2'-6" and a maximum of 6'-0" above the lowest adjacent grade. For the purpose of this estimate these are assumed to be 900 sq.ft. single-wide sectional trailers.
- Mobile Home, High Lift - This includes manufactured homes raised a minimum of 6'-6" and a maximum of 13'-0" above the lowest adjacent grade. For the purpose of this estimate these are assumed to be 900 sq.ft. single-wide sectional trailers.
- Pier-supported Frame House, Low Lift - This includes wood frame houses built on a pier and beam foundation raised a minimum of 2'-6" and a maximum of 6'-0" above the lowest adjacent grade. For the purpose of this estimate single story are assumed to be 1,866 sq.ft. and two-story homes are assumed to be 2,3239 sq.ft.; footprint square footage.

- Pier-supported Frame House, High Lift - This includes wood frame houses built on a pier and beam foundation raised a minimum of 6'-6" and a maximum of 13-0" above the lowest adjacent grade. For the purpose of this estimate single story are assumed to be 1,866 sq.ft. and two-story homes are assumed to be 2,239 sq.ft.; footprint square footage.
- Slab-supported Frame House, Low Lift - This includes wood frame houses built on a concrete slab raised a minimum of 2'-6" and a maximum of 6-0" above the lowest adjacent grade. For the purpose of this estimate single story are assumed to be 1,866 sq.ft. and two-story homes are assumed to be 2,239 sq.ft.; footprint square footage.
- Slab-supported Frame House, High Lift - This includes wood frame houses built on a concrete slab raised a minimum of 6'-6" and a maximum of 13-0" above the lowest adjacent grade. For the purpose of this estimate single story are assumed to be 1,866 sq.ft. and two-story homes are assumed to be 2,239 sq.ft.; footprint square footage.

The work process for Mobile Homes and Pier-supported frame houses was:

1. Complete program application.
2. Government obtains design build contract and works with approved contractors to develop Guide Plans and Individual Structure Specifications, and Estimates for phased increments.
3. Individual Site Specifications are approved.
4. Contractor obtains all necessary permits and Mobilize to site.
5. Residents temporarily relocate.
6. Disconnect utilities.
7. Place Jacks and Cribbing.
8. Insert Steels.
9. Elevate Structure.
10. Install Piers.
11. Set Structure on Piers.
12. Anchor Structure.
13. For High Lifts, pour grade beams between piers and slab-on-grade.
14. Reconnect Utilities.
15. For Low Lifts, install Perimeter Enclosure.
16. Install elevated landings and stairs.
17. Demobilization and Closeout.

The work process for Slab-supported houses was:

1. Complete program application.
2. Government obtains design build contract and works with approved contractors to develop Guide Plans and Individual Structure Specifications, and Estimates for phased increments.
3. Individual Site Specifications are approved.
4. Contractor obtains all necessary permits and Mobilize to site.

5. Residents temporarily relocate.
6. Disconnect utilities.
7. Excavate at perimeter and tunnels under slab on 8' centers.
8. Place Jacks and Cribbing.
9. Push segmented piles to refusal.
10. Elevate Structure.
11. Install Piers.
12. Anchor Structure.
13. For lower lifts, demo existing driveway and install new driveway adjusted to garage floor elevation.
14. For High Lifts, pour grade beams between piers and slab-on-grade.
15. Reconnect Utilities.
16. For Low Lifts, install Perimeter Enclosure.
17. Install elevated landings and stairs.
18. Demobilization and Closeout.

Commercial Floodproofing Projects were group according to these categories:

- Commercial Dry Floodproofing – This includes protecting the lower 3' of the structure from floodwater inundation. The average square footage was estimated according to occupancy type and ranged from 2,885 SF for an auto repair facility to 9,597 SF for professional office space.
- Commercial Wet Floodproofing – This includes retrofitting the building so that water may enter the building without causing any major damage. The average square footage was assumed to be 18,043 SF.

The work process for dry floodproofing was:

1. Complete program application.
2. Government obtains design build contract and works with approved contractors to develop Guide Plans and Individual Structure Specifications, and Estimates for phased increments.
3. Individual Site Specifications are approved.
4. Contractor obtains all necessary permits and Mobilize to site.
5. Demolition
6. Concrete Foundation Work
7. Construct Flood Barrier
8. Construct Brick Veneer
9. Install Self Closing Flood Barriers for entrances

The work process for wet floodproofing was:

1. Complete program application.
2. Government obtains design build contract and works with approved contractors to develop Guide Plans and Individual Structure Specifications, and Estimates for phased increments.
3. Individual Site Specifications are approved.

4. Contractor obtains all necessary permits and Mobilize to site.
5. Electrical Work
6. Install elevated storage racks
7. Wet floodproofing
8. Protective coatings
9. Install flood vents
10. Install crane to raise contents
11. Install an elevated office.

6.5.2 Quantity Development

Field teams visually inspected each structure that was identified on a map based on x, y coordinates assigned to structures appearing on aerial photos. The team estimated the number of square feet for the total structure, along with other characteristics, such as one or two-story, slab or pier foundations, etc. An "average structure" was calculated for each type (one or two-story, slab or pier foundations, mobile homes) and this "average structure" was used to develop the structure elevation costs for each type in Mii. Similar averages were used for non-residential structures for floodproofing and warehouses.

6.5.3 Bid Competition

It was assumed that there will not be an economically saturated market and that bidding competition will be present.

6.5.4 Contract Acquisition Strategy

There is no declared contract acquisition plan/type at this time and it was anticipated that the Federal Government will not issue individual contracts directly. Any contracts would be directly between property owners and contractors. The base estimate assumes open and competitive bidding, which is the traditionally employed contract procurement method for this type activity.

6.5.5 Labor Shortages

It was assumed there will be a normal labor market.

6.5.6 Labor Rates

Local labor market wages are above the local Davis-Bacon Wage Determination and actual rates have been used. This was based upon local information and payroll data received from the New Orleans District Construction Representatives and estimators with experiences in past years.

6.5.7 Materials

Cost quotes are used on major construction items when available, although quantities per site are small relatively speaking. The MII Costbook was also used for some materials. It was assumed that materials will be purchased as part of the construction contract. The

estimate does not anticipate government furnished materials. Prices include delivery of materials.

6.5.8 Equipment

Equipment rates used are primarily based from the latest USACE EP-1110-1-8, Region III. For specialty equipment required, industry practice was assumed and followed in the cost estimates. Example: structure jacking system quotes from Jahns Structure Jacking Systems Inc. were entered in USACE CheckRate spreadsheet to develop an hourly equipment rate for use in Mii.

6.5.9 Crews

Major crew and productivity rates were developed and studied by ARCADIS engineers in conjunction with local professionals familiar with the type of work. All of the work is typical to the Louisiana area. The crews and productivities were checked by local MVN senior cost engineers, discussions with contractors, and comparisons with historical cost data. Crew work hours are assumed to be 8 hours 5 days per week, which is typical to the area and type of work.

6.5.10 Relocation Cost

Not applicable.

6.5.11 Mobilization

Contractor mobilization and demobilization are based on the assumption that most of the contractors will be coming from within the Gulf Coast/Southern region. Minimal equipment is required for the NED non-structural work.

6.5.12 Field Office Overhead

Included in Mii cost estimates.

6.5.13 Home Office Overhead

Included in Mii cost estimates.

6.5.14 Taxes

Local taxes will be applied, using an average between the parishes that contain the work. Reference the LA parish tax rate website: http://www.laota.com/pta.htm

6.5.15 E&D and S&A

USACE costs to manage design (PED) and construction (S&A) are based on New Orleans District Programmatic Cost Estimate guidance:

6.5.16 Planning, Engineering & Design (PED)

Itemized line item costs are included in the direct costs for specific implementation/administrative steps (Gov't and contractor) of each of the projects (non-Real Estate portion – Real Estate related costs covered under Acct 01). Additional PED costs have been included in the 30 Acct PED for more overall programmatic efforts such as Project Management, Planning & Environmental Compliance, Contracting, Planning during Construction, and Project Operations.

6.5.17 Supervision & Administration (S&A)

Itemized line item costs are included in the direct costs for specific implementation/administrative steps for the Government administration of each of the projects (non-Real Estate portion – Real Estate related costs covered under Acct 01). Additional more general S&A costs have been included in the 31 Acct S&A for more overall programmatic Construction Management efforts. It was anticipated that construction actions will be directly between building owner and the contractor they select.

6.5.18 Contingencies

Contingencies were developed using the USACE Cost and Schedule Risk Analysis (CSRA) process and the Crystal Ball software that evaluates schedule and cost related risks. See summaries in Cost Schedule Risk Analysis (CSRA) section.

6.5.19 Escalation

Escalation used in the Mii and TPCS was based upon the latest US Army Corps of Engineers Engineering Manual (EM) 1110-2-1304 Civil Works Construction Cost Index System (CWCCIS).

6.5.20 HTRW

The estimates include no costs for any potential Hazardous, Toxic, and Radioactive Waste (HTRW). HTRW issues are not expected and project features could be revised to avoid. HTRW will be avoided at all costs.

References

Dunbar, J.B., Blaes, M.R., Dueitt, S.E., May, J.R., Stroud, K.W., 1994. Geological investigation of the Mississippi River Deltaic Plain. Report 2, Technical Report GL-84-15. Prepared for the U.S. Army Corps of Engineers, New Orleans.

Mange, M. and Otvos, E., 2005. Gulf Coastal Plain Evolution in West Louisiana: Heavy mineral Provenance and Pleistocene Alluvial Chronology. Sedimentary Geology. 182 (1-4), 29-57.

South Central Coast Study: ARCADIS, U.S., Inc. 2017. *South Central Coast Louisiana Flood Protection Study*. Prepared for the Coastal Protection and Restoration Authority.

ER 1105-2-101: Risk Assessment For Flood Risk. Management Studies (2017)

EM 1110-2-1913: Design and Construction of Levees (April 2000)

EM 1110-2-1902: Slope Stability (October 2003)

EM 1110-1-1904: Settlement Analysis (September 1990)

EC 1110-2-6066: Design of I-Walls (April 2000)