State of Louisiana

Coastal Protection and Restoration Authority (CPRA)

2017 Operations, Maintenance, and Monitoring Report

for

Cote Blanche Hydrologic Restoration

State Project Number TV-04
Priority Project List 3

June 2017
St. Mary Parish

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2017 Operations Maintenance and Monitoring Report
For
Cote Blanche Hydrologic Restoration (TV-04)

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Preface

This report includes monitoring data collected through December 2013, and annual Maintenance Inspections through May 2017.

The 2017 report is the 5th and final report. NRCS is the federal sponsor for TV-04 and this project is ranked PPL 3 on the CWPPRA priority list. For additional information on lessons learned, recommendations and project effectiveness please refer to previous OM&M reports (2004, 2008, and 2011) as well as annual O&M inspection reports (2005-2017) on the CPRA website (http://lacoast.gov/new/Projects/Info.aspx?num=TV-04).

I. Introduction

The Cote Blanche Hydrologic Restoration project (TV-04) area comprises 30,898 acres (12,504 ha) of freshwater and intermediate marsh located in St. Mary Parish. The project boundaries include the Gulf Intracoastal Waterway (GIWW) to the north, Highway 317 to the east, East Cote Blanche Bay (ECBB) to the south and West Cote Blanche Bay (WCBB) to the west (Figure 1). The Cote Blanche marsh, and other marshes in this region, have experienced increased freshwater introduction from the GIWW and westward currents from the Atchafalaya delta (DeLaune et al. 1987). Since 1949, when the area was almost entirely brackish, the marsh type has freshened (Table 1).

Table 1. Vegetation classifications of the Cote Blanche Hydrologic Restoration project area (TV-04) from historical surveys. Vegetation Class "Other" includes water, swamp, and developed land. The data was obtained from the Coastwide Reference Monitoring System (CRMS) website (http://www.lacoast.gov/crms_viewer2/Default.aspx) on May 25, 2017.

	Vegetation Classification (% area)					
Year	Fresh	Intermediate	Brackish	Saline	Other	Source
1949	0.12	---	92.19	6.43	1.26	O'Neil 1949
1968	20.28	35.64	42.70	---	1.38	Chabreck et al. 1968
1978	59.82	6.96	30.49	---	2.73	Chabreck and Linscombe 1978
1988	95.03	---	---	---	4.98	Chabreck and Linscombe 1988
1997	96.21	---	---	---	3.79	Chabreck and Linscombe 1997
2001	35.09	61.25	---	---	3.61	Linscombe and Chabreck N.D.
2007	65.46	30.88	---	---	3.66	Sasser et al. 2007
2013	84.25	12.00	---	---	3.71	Sasser et al. 2013

The GIWW and numerous oilfield canals have caused hydrologic changes within the project area. The Humble and Humble-F canals were dredged between 1937 and 1958; the British-American Canal and extensions from the Humble Canal were dredged between 1958 and 1974 (Figure 1). These major canals are believed to have increased tidal action and rapid water exchange between the interior marsh and East and West Cote Blanche Bays. Marsh degradation was first detected in 1952 aerial photography in an area west of the British-American Canal. Canal dredging is blamed for accelerating marsh loss in the area. The average land loss rate for the project area was estimated at -73 ac/yr (29 ha/yr) based on aerial

photography from 1957 to 1990 (Britsch and Kemp 1990). Rapid water exchange and increased tidal fluctuations have caused breaches in spoil banks of interior canals and are likely responsible for erosion and conversion of fragmented marsh to open water as organic, marsh soils are easily eroded. Although sediment-laden water is available from the bays and the GIWW, rapid water exchange appears to inhibit sediment and nutrient deposition (Louisiana Department of Natural Resources [LDNR] 1999).

Shoreline erosion on the southern project boundary along ECBB resulting from wave energy and breaches in adjacent canals was evident from aerial photography as early as 1952. Shoreline erosion rates averaged -10 to -15 ft/yr (-3.0 to -4.6 m/yr) from 1952-1995 according to a report from Miller Engineers & Associates. These measurements are consistent with an increase in shoreline erosion after 1978 for the entire Teche/Vermilion basin. Erosion rates averaged -10 to -12 ft/yr (-3.0 to -3.7 m/yr) from 1941 to 1978 and increased to an average of -20 to -25 ft/yr (-6.1 to -7.6 m/yr) from 1978 to 1983 for the basin.

The main focus of this hydrologic restoration project is to create a lower energy environment by reducing the larger openings of oil-field access canals that penetrate fragile interior marsh and act as direct conduits for increased tidal influence from East and West Cote Blanche Bays. Water control structures were designed to reduce cross-sectional areas of major waterways thereby reducing tidal fluctuation and rapid water exchange between bays and interior fragmented marshes. Channel reduction with weirs and boat/barge bays rather than restrictive structures (e.g. flap-gated weirs or plugs) allows for continued delivery of freshwater and sediments and navigation access to the project area under a lower energy regime.

To achieve the specific goals of decreasing water level variability within the project area and decreasing the rate of marsh loss, seven passive water control structures were constructed in seven major water exchange avenues in 1999:

1) The feature at Mud Bayou is a fixed-crested weir with boat bay that spans the 165-foot-width of Mud Bayou and is composed of steel sheet piling with rock armored wing walls. This structure has 81ft of total weir length with 66 feet set at a crest elevation of -1.5ft North American Vertical Datum (NAVD), and 15 feet as a boat bay at an elevation of -5.5ft NAVD.

2) The feature at Humble-F Canal is a fixed-crested weir with boat bay that spans the 200-foot-width of Humble-F Canal and is composed of a combination of rock riprap center section and steel sheet piling wing walls with rock-armored ends. This structure has an 80ft total weir length with 65 feet set at a crest elevation of -0.5ft NAVD, and 15 feet as a boat bay at an elevation of -2.5ft NAVD.

3) The feature at Bayou Long is a fixed-crested weir with boat bay that spans the 300-foot-width of Bayou Long and is composed of steel sheet piling with rock armored wing walls. This structure has 79ft of total weir length with 64 feet set at a crest elevation of -1.5ft NAVD, and 15 feet as a boat bay at an elevation of -3.5ft NAVD.

4) The feature at Bayou Carlin is a fixed-crested weir with a boat bay that spans the 225-foot-width of Bayou Carlin and is composed of steel sheet piling with rock armored wing walls. This structure has 79ft of total weir length with 64 feet set at a crest elevation of -1.5ft NAVD, and 15 feet as a boat bay at an elevation of -3.5ft NAVD.

5) The feature at Humble Canal is a fixed-crested weir with a barge bay that spans the 400-foot-width of Humble Canal and is composed of a combination of rock riprap center section and steel sheet piling wing walls with rock-armored ends. This structure has 260ft of total weir length with 190 feet set at a crest elevation of -1.5ft NAVD, and 70 feet as a barge bay with an elevation of approximately -8.5ft NAVD.

6) The feature at Jackson Bayou is a fixed-crested weir that spans the 100-foot-width of Jackson Bayou and is composed of steel sheet piling with rock armored wing walls. This structure has a 16-foot-wide weir length set at a crest elevation of -3.5ft NAVD.

7) The feature at the British-American Canal is a fixed-crested weir with a boat bay that spans the 160-foot-width of the British-American Canal and is composed of a combination of rock riprap center section and steel sheet piling wing walls with rock-armored ends. This structure has an 80ft total weir length with 65 feet set at a crest elevation of -0.5ft NAVD, and 15 feet as a boat bay at an elevation of -2.5ft NAVD.

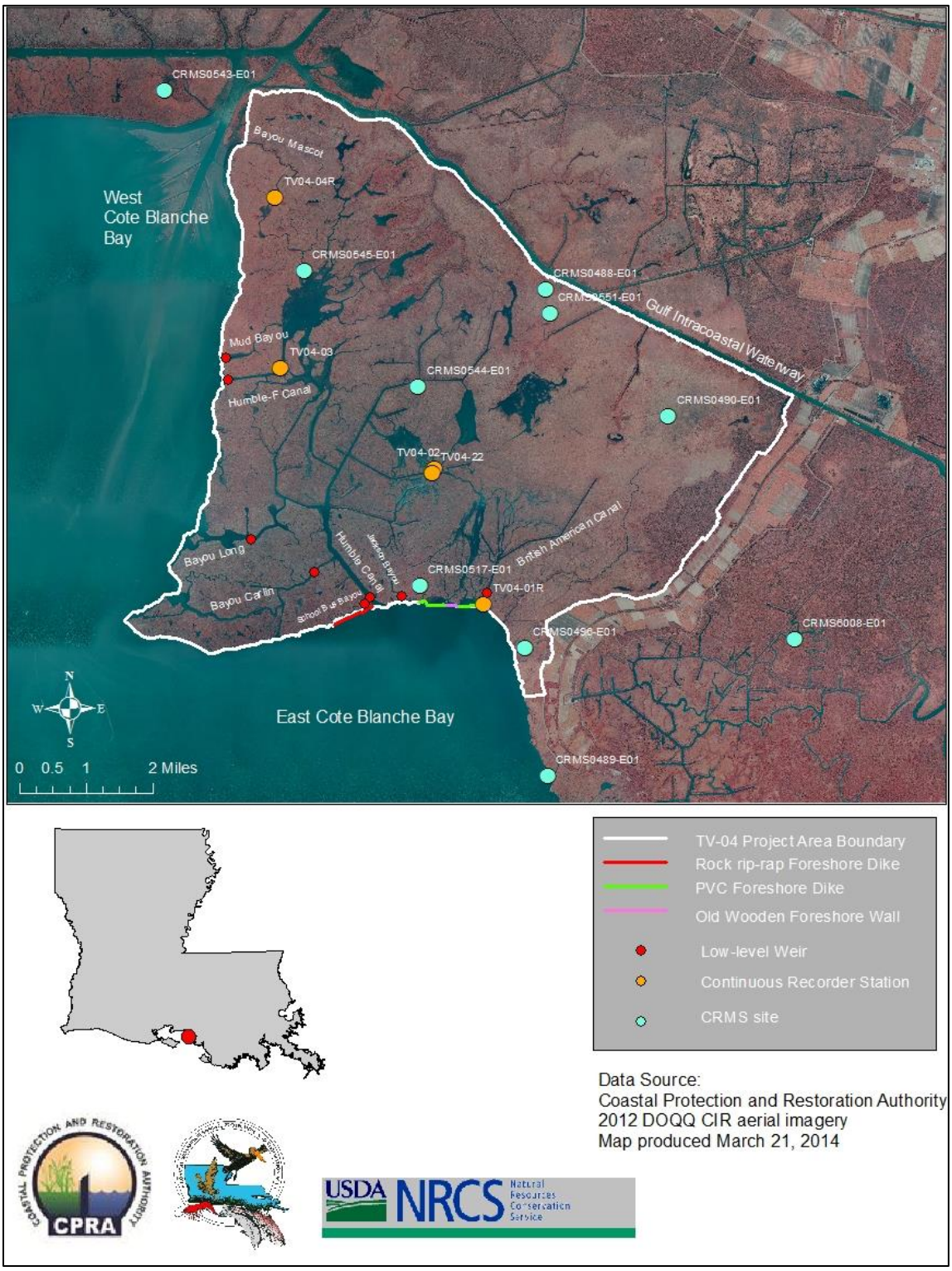

Figure 1. Cote Blanche Hydrologic Restoration (TV-04) project area boundary and features.

To address the second objective and the specific goal of reducing shoreline erosion along the southern project boundary between the British American Canal and Jackson Bayou, a 4,140 ft foreshore wall was constructed in two sections located on either side of, and overlapping the ends of an existing wooden bulkhead. The wall is composed of PVC sheet piling attached to timber wales and supported by timber soldier and batter piling. Approximately 2 cubic yards of surface coarse aggregate limestone per linear ft. was placed on each side of the PVC sheet piling and extended out from the sheet piling approximately 15 linear feet. Construction on the seven weirs and the wall was completed January 20, 1999.

By 2007, ECBB had breached into School Bus Bayou (SBB), which runs parallel to ECBB and intersects Humble Canal, allowing tidal water to bypass the weir located on Humble Canal (Figure 1). In response, two passive water control structures and shoreline protection was added to the project. The two control structures installed on the eastern and western side of Humble Canal where School Bus Bayou crosses are low-level, rock weirs with a bottom sill 10 feet wide and -2.0 feet NAVD deep on the eastern weir and a sill 15 feet wide and -6.0 feet NAVD deep on the western weir. Approximately 3,500 linear feet of foreshore rock dike along the northern shoreline of ECBB was installed parallel to School Bus Bayou just west of the Humble Canal. Construction in the School Bus Bayou area was completed in September 2007.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Cote Blanche Hydrologic Restoration Project (TV-04) is to evaluate the constructed project features to identify any deficiencies and prepare a report detailing the condition of project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, CPRA shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs. The annual inspection report also contains a summary of maintenance projects, if any, which were completed since completion of constructed project features and an estimated projected budget for the upcoming three (3) years for operation, maintenance and rehabilitation. The three (3) year projected operation and maintenance budget is shown in Appendix B.

An inspection of the Cote Blanche Hydrologic Restoration Project (TV-04) was held on June 26, 2017 under mostly cloudy skies and warm temperatures.
In attendance were Stan Aucoin and Darrell Pontiff of CPRA and Nick McCoy of NRCS. Rick Hartman of NOAA was there for inspections on other projects.

The field inspection included a complete visual inspection of all features. Staff gauge readings, when available, were used to determine approximate elevations of water, rock weirs, earthen embankments, steel bulkhead structures and other project features. Photographs were taken at each project feature (see Appendix A) and Field Inspection notes were completed in the field to record measurements and deficiencies (see Appendix C).

b. Inspection Results

Site 1—Mud Bayou

The Mud Bayou structure remains in fair shape. Rust on the sheet piles and the pile cap continues. The railings have been replaced with stainless steel cable and are holding up well. The north danger sign is missing and will not be replaced. Erosion of the bank on the south side of the structure is becoming apparent. Staff gauges are no longer functional. (Photos: Appendix A, Photo 1, 18)

Site 2—Humble F Canal

Both pilings and arrow signs replaced during the last maintenance event (north side) is missing, again. Stainless steel cables remain. Sheet piles and rocks on the end of the structure are stable and functioning as intended. Rust on the sheet piles will be monitored. The bayshore continues to erode in front of this structure to the point that the structure is near the bayshore. (Photos: Appendix A, Photo 2, 18)

Site 3—Bayou Long

The structure is in fair to good post-maintenance condition. Rusting on the sheet piles has significantly worsened. (Photos: Appendix A, Photo 3, 18)

Site 4—Bayou Carlin

The structure is in fair to good post-maintenance condition. Pilings and stainless cables are all in place and functioning. Rusting on the sheet piles wasn't evaluated due to massive water hyacinth build-up. (Photos: Appendix A, Photo 5-7, 18)

Site 5—Humble Canal

The pile cap on the eastern side of the structure is completely gone. The cables installed to replace the rails continue to function as intended except where it was attached to the pile cap on the eastern side. Rock that was placed to extend the keyway closure has settled but is in otherwise good shape. Signage/lighting is all stable. Rust continues to worsen. (Photos: Appendix A, Photos 5-7, 18)

School Bus Bayou

The dike was completely submerged due to high tides and was unable to be inspected. Signage along the bayshore is intact. Rock at the eastern intersection of School Bus Bayou and Humble Canal is in place and stable. No rock was found on the western side. Signage for the two weirs at the crossings is ok. (Photos: Appendix A, Photos 8-10)

Site 6—Jackson Bayou

Rust continues at this site. Erosion, especially on the western side of the structure is worsening. The gap between the eastern end of the structure and the shoreline has been somewhat stabilized with rock that was placed between the structure and the shoreline during construction of the new PVC wall. This area could use some additional rock. Signage is stable. (Photos: Appendix A, Photos 11-12, 18)

Site 7—British American Canal
Rust on the sheet piles continues to worsen and will be monitored as well. The port side day marker and timber pile are gone. Rock along the shoreline between the structure and the PVC wall is also in excellent shape. (Photos: Appendix A, Photos 13-14, 18)

Site 8—PVC Wall
The original PVC shoreline protection wall continues to show signs of age and is in need of some repair. Several areas have either sheet pile or whalers missing or deteriorated. Hardware is rusting significantly. Some of the timber piles are also showing signs of decay. The wall, for the most part, is still functioning as intended. Signs are all in place and stable. The two new wall sections that were installed during the 2015 maintenance event have basically failed. Approximately 80% of the total length is damaged or missing. Timber piles are still in place and stable. Scour at the base, that was noticed during the final inspection is still evident but stable. However, rock should be placed at the base of this new wall when this wall is repaired/replaced. (Photos: Appendix A, Photo 15-17)

c. Maintenance Recommendations

i. Immediate/Emergency
The PVC walls are in poor condition and are in need of repair. Pilings are still in place; however, sheet piles and whalers are missing or broken.

ii. Programmatic/Routine
Rock will be needed in the future to combat bankline erosion at the following features: Mud Bayou, Humble Canal, School Bus Bayou, and Jackson Bayou. Shoreline retreat near some of the structures may require alternative solutions.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since January 1999, the construction completion date of the Cote Blanche Hydrologic Restoration Project.

2001 Maintenance Project – LDNR: This maintenance project included the placement of 12”-14” of paving stone spread out around the wingwalls of the weirs at Mud Bayou, Humble F Canal, Bayou Long, Humble Canal, Jackson Bayou and British American Canal to “harden” the area while still allowing flow in extreme tidal events to pass around the structure without washing away the existing bank. Also included was the replacement of approximately 100 pile caps along the PVC wall, the replacement of day markers at Humble F Canal with signs mounted to the weir instead of on driven pylons, and the construction of revetment/foreshore dike along the west

bank of the British American Canal from the weir to the canals convergence with Cote Blanche Bay. The costs associated with the engineering, design and construction of the Cote Blanche Maintenance Project are as follows:

Construction------	$287,919.80
E & D, construction oversight, as-builts------	$ 31,690.79
Project Total------	**$319,610.59**

2005 Maintenance Project – LDNR: This maintenance project included rock repair at six of the structures, replacement of warning signs and channel markers. This project was a result of damages that occurred during Hurricane Lili in 2002.

Project Cost	$84,500.00*

*This cost was reimbursed by FEMA

2007 School Bus Bayou Maintenance – LDNR: This maintenance event consisted of the installation of approximately 3,500 linear feet of foreshore rock dike along the northern shoreline of Cote Blanche Bay just west of the Humble Canal and in the vicinity of School Bus Bayou. Also, two low level rock weirs were installed on the eastern and western side of Humble Canal where School Bus Bayou crosses. Associated costs are as follows:

Construction	$1,500,000.00
E&D/Const. oversight	$63,328.45
Total	**$1,563,328.45**

2011/2012 School Bus Dike Maintenance – CPRA: This event consisted of raising the School Bus Bayou dike back to grade, replacing various signs on structures, replacing the weir on the western intersection of School Bus Bayou and Humble Canal, and extending the rock revetment on the eastern bank of Humble Canal to the south. Construction was accepted as complete on January 13, 2012 and costs were as follows:

Construction	$730,888.40
E&D/Const. oversight	$96,663.13
Total	**$827,551.53**

2015 PVC Wall Extension—CPRA: This event consisted of installing 1,770 LF of new PVC wall, 1,370 LF on the west side of Jackson Bayou and 400 LF on the east side. Also, various signs and rails on structures were replaced or repaired.

Construction	$1,116,450.00
E&D/Const. oversight	$195,552.20
Total	**$1,312,002.20**

Navigational Light Maintenance – LDNR: Automatic Power, Inc. performed the following navigational light maintenance:

2007 Thru 2016 **$22,682**

III. Operation Activity

a. Operation Plan

There are no active operations with this project; therefore no Structural Operation Plan is required.

b. Actual Operations

There are no active operations associated with this project.

IV. Monitoring Activity

Pursuant to the CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS) for CWPPRA project monitoring, updates were made to merge the TV-04 Monitoring Plan with CRMS and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. Three project specific data recorders were officially removed from the project and reference areas on March 8, 2007 following approval from the federal sponsor, NRCS. Seven CRMS-*Wetlands* sites are located in the project area (Figure 1) and other CRMS sites are available as references.

a. Monitoring Goals

The objectives of the Cote Blanche Hydrologic Restoration Project are:

1. Reduce water exchange between marshes of Cote Blanche and West and East Cote Blanche Bays to prevent scouring of interior marsh and protect approximately 30,898 ac (12,504 ha) of fresh marsh.

2. Protect shoreline on southern boundary between Jackson Bayou and British-American canals from wave erosion.

The following goals will be evaluated to assess the above objectives:

1. Decrease variability in water level within the project area.

2. Reduce erosion rate of shoreline along southern project boundary.

3. Decrease rate of marsh loss.

b. Monitoring Elements

Water Level Variability

To assess the effectiveness of low-level, passive weirs in reducing water level fluctuation in the project area, differences in daily water level ranges inside and outside of the project area were analyzed (Figure 1; Table 2). Daily water elevation ranges, calculated from the maximum and minimum hourly data, were plotted over time. Relevant time intervals were picked based on switching from TV-04 project specific to CRMS sondes, project construction events, and storm disturbance (Table 2). From the TV-04 project specific sondes (June 1997 – November 2004), TV04-02/22 and TV04-03 were project sondes, and TV-01R was the reference sonde. From the CRMS sondes (November 2006 – December 2016), CRMS0544 and CRMS0545 were project sondes, and CRMS0517 and CRMS0543 were averaged as the reference sondes.

For statistical analysis, the difference in daily water level range between reference and project sondes were calculated, and the mean and standard errors were compared among the time intervals:

$$\text{Mean Range Difference} = \frac{\Sigma_{days}(\text{Range}_{proj} - \text{Range}_{ref})}{\text{n days}}$$

Range difference calculations were limited to dates that had both the reference and project data; also, days within an acceptable range of 0.05-3.5 ft for reference sondes were used for the analysis to limit anomalous days (such as storm surge effects) and/or sonde errors. During the time of the project-specific sondes (1997-2004), range differences of project sondes were calculated as a difference from the reference sonde; the final water level data collected from the reference sonde was in November 2004. To incorporate natural variability and defend against data gaps from individual sondes during the time that CRMS sondes were used (2006-2010), two reference sondes were averaged from which range differences for project sondes were calculated. Although CRMS0517 is within the project area and behind the PVC wall, the bayou in which the sonde is located is directly connected to ECBB as the PVC wall is slotted to allow for water passage and is not tied-in to the shoreline. The daily range differences were grouped by time intervals of interest for each data set, TV-04 and CRMS (Table 2). The different sets of project sondes are affected by the same low-level weirs with

the CRMS sondes being further interior; TV04-02/22 and CRMS0544 are behind the Humble Canal weir, and TV04-03 and CRMS0545 are behind the Humble F Canal and Mud Bayou weirs. CRM0545 is also connected to Bayou Mascot to the north which is not influenced by a weir. Differences between water level ranges of project sondes and among time intervals for each data set were analyzed using a full factorial (sonde × time interval) analysis of variance (ANOVA); differences within factors were detected with Tukey Honest Significant Differences (HSD) post tests (SAS Institute Inc. 2010, 2015).

Table 2. Time intervals based on sonde set, project construction/maintenance, and storms were used to determine daily range differences for assessing water level variability at East Cote Blanche Bay Hydrologic Restoration project (TV-04) from 1997-2016. The TV-04 project specific sondes were TV04-02/22 and TV04-03 for the in-project sondes and TV04-01R for the reference; and, respectively, the CRMS sondes were CRMS0544 and 0545 for the in-project sondes and an average for CRMS0517 and CRMS0543 for the reference sondes.

Date Range	Name
TV-04 Project Specific Sondes	
June 1997 - March 1998	Pre TV-04 Construction
February 1999 - August 2002	Post TV-04 Construction
September 2002 - November 2004	Post Hurricane Lili
CRMS Sondes	
November 2006 - August 2007	Pre School Bus Bayou (SBB) Foreshore Dike
September 2007 - November 2010	Post SBB Foreshore Dike
December 2010 - December 2011	SBB Breach/Humble Canal Bypass
January 2012 - April 2013	Post SBB weirs and dike lift
May 2013 - June 2015	Jackson Bayou Structure Breach
July 2015 – December 2016	Jackson Bayou Structure Repair and PVC wall extension

Shoreline Change

Using differential GPS, the southern boundary shoreline along ECBB was mapped east and west of Humble Canal behind shoreline protection structures (foreshore rock dike to the east and foreshore PVC wall and pre-existing wooden bulkhead to the west) and unprotected areas to the east and west. The wooden bulkhead is a previously existing structure constructed as a shoreline protection measure in the late 1950s. Shorelines were mapped in 1998 (PVC wall construction), 2001, 2004, 2007 (rock dike construction), 2010, 2013, and 2016. Change rates for time intervals were calculated using Digital Shoreline Analysis System (DSAS) version 4.0, an ArcGIS application. Transects spaced 20 m apart were established for the shoreline reaches from which shoreline change rates (m/y) were determined between mapping dates and overall (1998-2016) (Thieler et al. 2009). Shoreline change rates among shoreline reaches over the time intervals were compared using a full factorial (shoreline reach × time interval) ANOVA; differences among shoreline reaches within time intervals were detected with Tukey HSD post tests. In addition, a comparison of the shoreline reaches over the life of the project to date (1998-2016) was analyzed using an ANOVA with a Tukey HSD post test (SAS Institute Inc. 2010, 2015).

Land Area Change

To document vegetated and non-vegetated areas, near vertical color-infrared aerial photography (1:24,000 scale with ground controls) were obtained pre-construction on January 11, 1997 and post construction on December 15, 2002, December 20, 2009. The final two sets of aerial photography were flown in October 2012 and December 2015 at 1 m^2 resolution as part of the CRMS coast-wide flight. The original photographs were checked for flight accuracy, color correctness, and clarity and were subsequently archived. Aerial photographs were scanned, mosaicked, and georectified by USGS/NWRC personnel according to standard operating procedures (Steyer et al. 1995, revised 2000). Habitat analysis was performed on the 1997 and 2002 aerial photography while a land and water analysis was performed on the 2009, 2012, and 2015 aerial photography; therefore, 1997 and 2002 habitat classifications were lumped into land (emergent, vegetated area) and water (open water and nonvegetated mudflats). Land area change in acres and percent land was determined from the slope of land area over time. An additional land-to-water analysis based on 30 m^2 resolution Landsat Satellite Thematic Mapper (TM) data was performed from February 2 to October 16, 2002 to detail land changes caused by Hurricane Lili (October 3, 2002). Unfortunately, the difference in resolution of the two data sets prohibits combining the spatial data. To provide temporal and regional context, land change data from other sources were analyzed for TV-04 pre-construction and the Teche/Vermilion basin pre- and post-construction time periods.

c. Monitoring Results and Discussion

Water level Variability

The low-level weirs are effectively reducing water level fluctuations within the TV-04 as the project intended. Monitoring data reveal that when breaches and bypasses form, the project effects are decreased. Monthly averages of daily water level range were calculated for project and reference stations from both the project specific TV-04 dataset and the CRMS dataset. Both datasets provide references representing conditions in East and West Cote Blanche Bays and interior sites in the western part of the project area near Mud Bayou and in the central part of the project area near Humble Canal. Time periods of interest were delineated in order to assess impacts of Hurricane Lili and breaches around structures (Figure 2). In the TV-04 dataset (1997-2004), reference (TV04-01R) and project (Humble Canal sonde at TV04-02/22 and Humble B Canal/Mud Bayou sonde at TV04-03) ranges were closer pre-construction than in post-construction time intervals as the water level range decreased at the project sondes (Figure 2A). To demonstrate changes in water level ranges within the project area relative to reference conditions, the daily water level range of the reference was subtracted from the project sondes. The range differences from each project sonde were averaged over the time intervals of interest and compared; their interaction was statistically significant (sonde × time interval, $F_{1,2}=23.7$, $p<0.0001$).

Prior to project construction, water level ranges within the project area were ~6% less on Humble Canal (TV04-02/22) and ~14% less at Mud Bayou (TV04-03) than in the bay (TV04-01R). Post-construction, differences between project and reference conditions were enhanced as tidal exchange was dampened but the project features (Figure 3A). In the time interval following project construction, the difference in water level range tripled at the Humble Canal sonde (TV-02/22) and doubled at the Mud Bayou sonde (TV04-03). After Hurricane Lili, the

range difference at Mud Bayou decreased by ~25% (Figure 3A) making it similar to the range difference at Humble Canal. Between November 2004 and November 2006, ECBB had breached into School Bus Bayou (SBB) allowing tidal water to bypass the weir located on Humble Canal which prompted construction of the SBB structures (weirs at intersection with Humble Canal and a foreshore rock dike).

Within the CRMS dataset (Nov 2006 – Dec 2016), differences between bay reference condition and interior marsh at Mud Bayou and Humble Canal continued to be significant different (sonde × time interval, $F_{1,5}$=9.99, p<0.0001) (Figure 3B). Water level range averaged greater at the Humble Canal (CRMS0544) sonde than the reference sondes ($CRMS_{Refs}$) prior to construction of the SBB structures as water was bypassing the Humble Canal weir and being held within the project area. Following the installation of the SBB foreshore dike, project effects could again be seen where water level ranges were typically lower in the project area than in the bay. In fact, after the SBB dike was constructed, the dynamic shifted in the project area such that the biggest difference between project and reference condition was near Humble Canal (~31% lower; Mud Bayou ~16% lower). Some of this may be due to the fact that the CRMS Mud Bayou sonde (CRMS0545) is open to WCBB to the north via Bayou Mascot (Figure 1) while the project specific sonde was more influenced by the Humble F Canal south of Mud Bayou. Subsequent hydraulic bypassing around the Humble Canal (via another SBB breach) and the Jackson Bayou (JB) structure caused project effects to be muted though still apparent. After the Jackson Bayou repairs, water level range inside the project area was lower than the bay by ~14% near Humble Canal and ~22% near Mud Bayou (Fig. 3B). Structures are effective at reducing water level range and the project is most effective when structures are fully functioning.

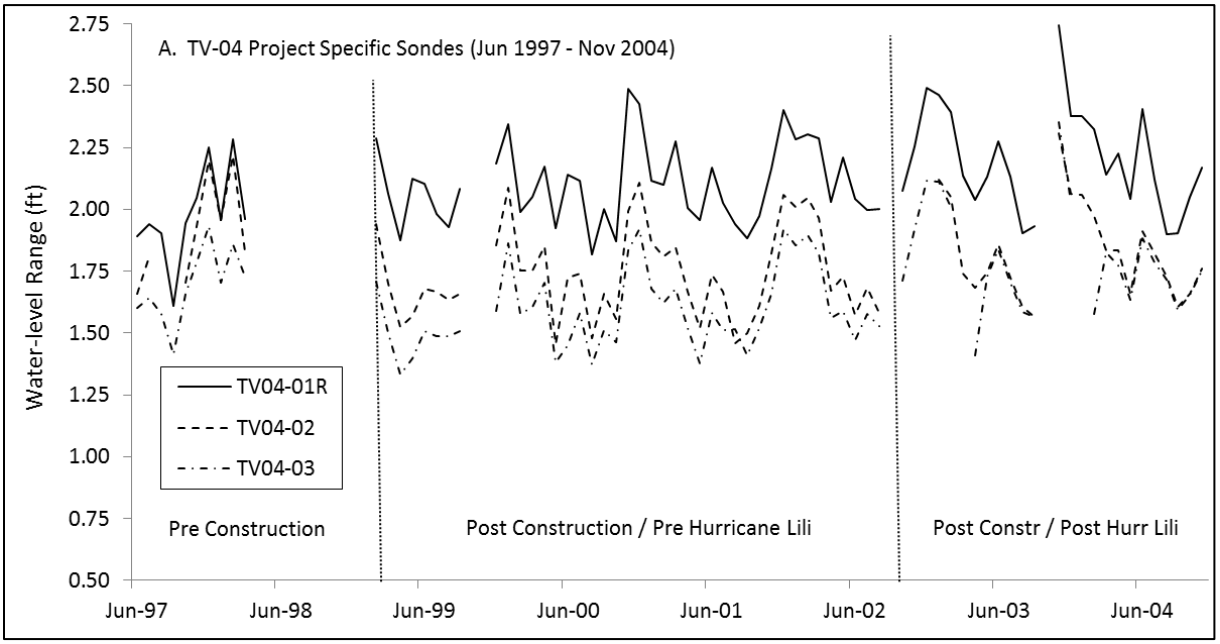

Figure 2A. Water level ranges (maximum – minimum per day) were collected over time from TV-04 project specific sondes (A) at reference and in project locations near Humble Canal (TV04-02) and Mud Bayou (TV04-03). Values are monthly means of daily ranges.

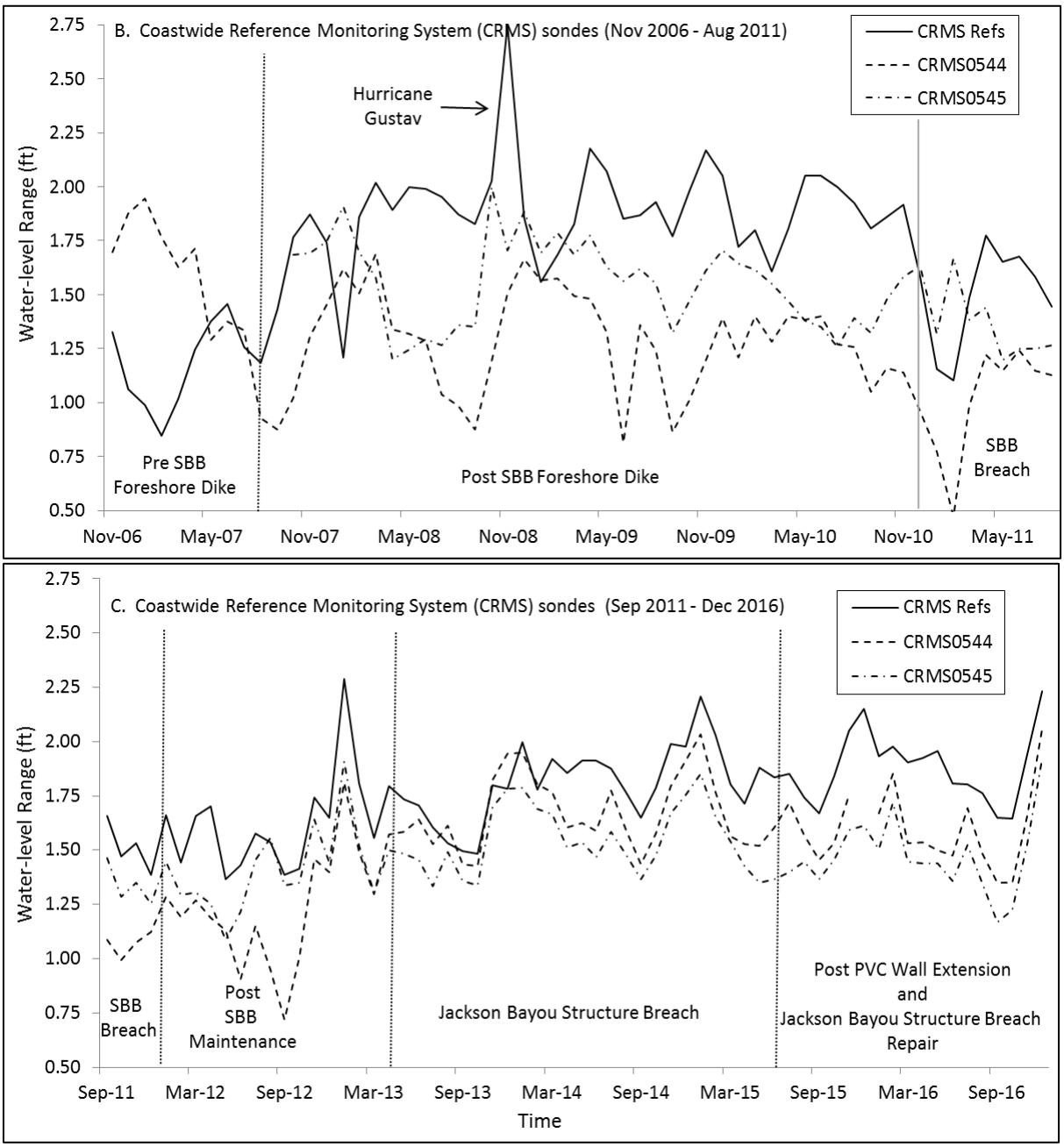

Figure 2B and C. Water level ranges (maximum – minimum per day) were collected over time from Coastwide Reference Monitoring System (CRMS) sondes (B. Nov 2006 – Aug 2011; C. Sep 2011 – Dec 2016) at reference and project locations near Humble Canal (CRMS0544) and Mud Bayou (CRMS0545). Values are monthly means of daily ranges.

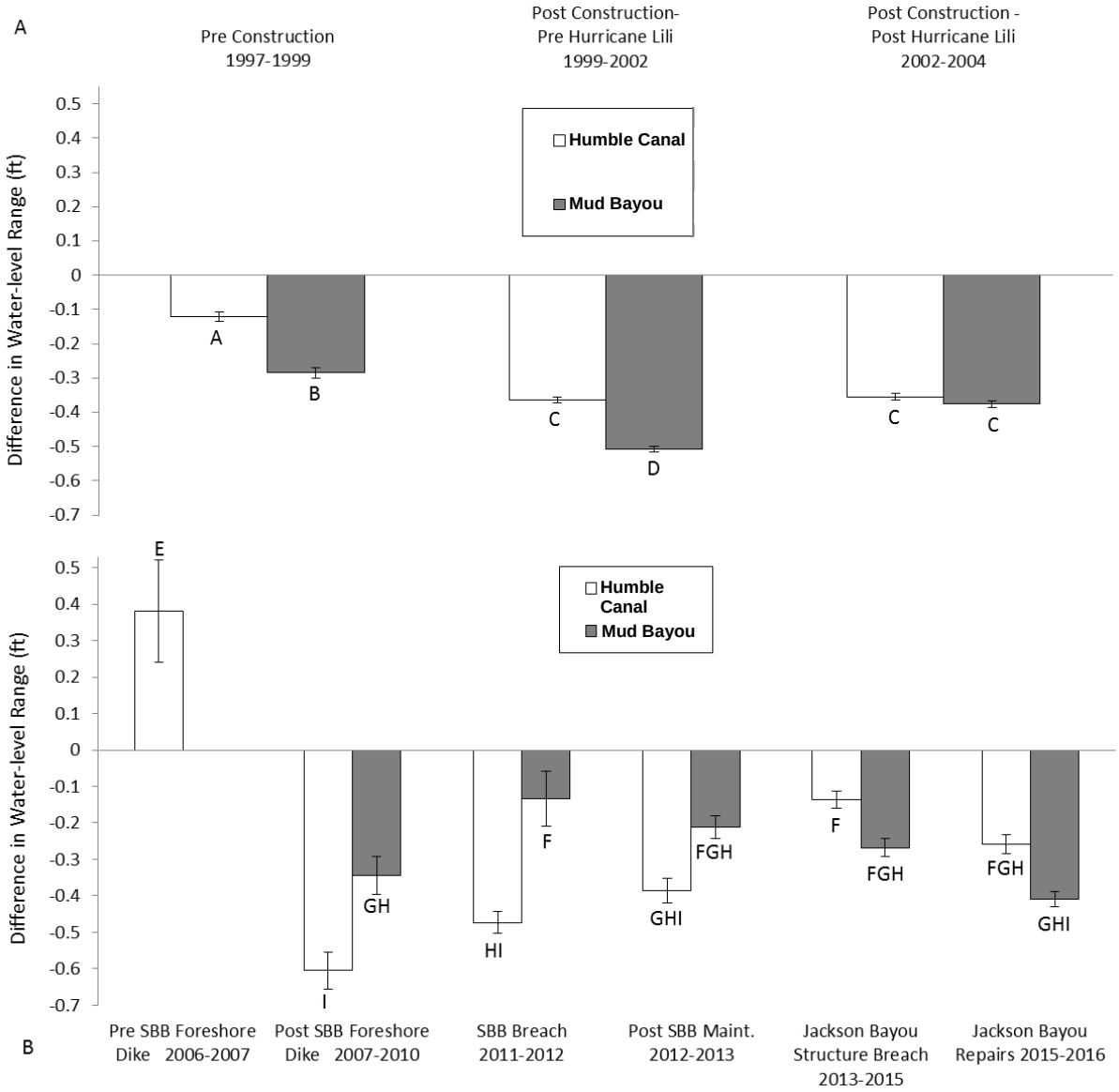

Figure 3. Difference in water level range ($Range_{proj\ i} - Range_{ref}$) collected over time intervals from (A) TV-04 Project Specific and (B) Coastwide Reference Monitoring System (CRMS) sondes at the Cote Blanche Hydrologic Restoration project (TV-04). Values are means and standard errors of daily range differences for a time interval. Each sonde set (A and B) was analyzed separately, and both had significant interaction (sonde × time interval) effects; the different letters indicate significant differences among columns within a sonde set.

Shoreline Change

Shoreline protection measures have effectively decreased erosion relative to unprotected shorelines although erosion has increased over time since Hurricanes Lili (2002), Rita (2005), and Gustav and Ike (2008).

The following is a description of shoreline change behind each shoreline segment/protection type from west to east. Note that features came onto the landscape at different times. The western unprotected shoreline change averaged -3.22 m/y (-10.56 ft/y) 1998-2016 and slightly increased by -0.15 m/y (-0.49 ft/y) over time. Erosion behind the foreshore rock dike decreased after installation in 2007, increased again as the rocks settled to below the target elevation and ECBB breached into SBB (2010-2013), and then decreased 2013-2016 after more rock was added to lift the elevation of the dike in January 2013. A PVC wall was installed in front of what was the western side of the eastern unprotected shoreline in 2015; the effect of the new PVC wall on erosion is difficult to interpret because installation was late in the 2013-2016 time intervals. The eastern unprotected shoreline had greatest erosion rates overall of -4.74 m/y (-15.55 ft/y); it also has the greatest erosion rate for a time interval in 2010-2013 (Fig. 4) which was the time frame that breaching around the Jackson Bayou was first noticed (2012) and water hyacinth was heavy during the 2013 mapping effort. Since construction, the shoreline behind the foreshore PVC wall eroded -1.47 m/y (-4.82 ft/y) significantly less than all other shoreline reaches; however, the effectiveness has decreased since Hurricane Lili as the shoreline was prograding through 2004 and then eroding thereafter. Among protection types, the PVC had the lowest erosion rate until 2013-2016 when erosion behind the PVC was greater than behind the foreshore rock dike (Fig. 4). The shoreline behind the pre-existing wooden bulkhead has an overall erosion rate of -3.99 m/y (-13.09 ft/y) and the highest change of erosion rates over time of -0.34 m/y (-1.12 ft/y). Since Hurricane Lili, it has become more dilapidated and less effective (Figures 4, 5, 6) as the protrusion of once protected marsh and tree lined shoreline behind the wooden bulkhead (Figs 1 and 5) has eroded (Fig. 6). As erosion continues behind all of the foreshore protection, the distance from the protection to the shoreline increases (wave fetch increases) allowing for more wave energy to develop.

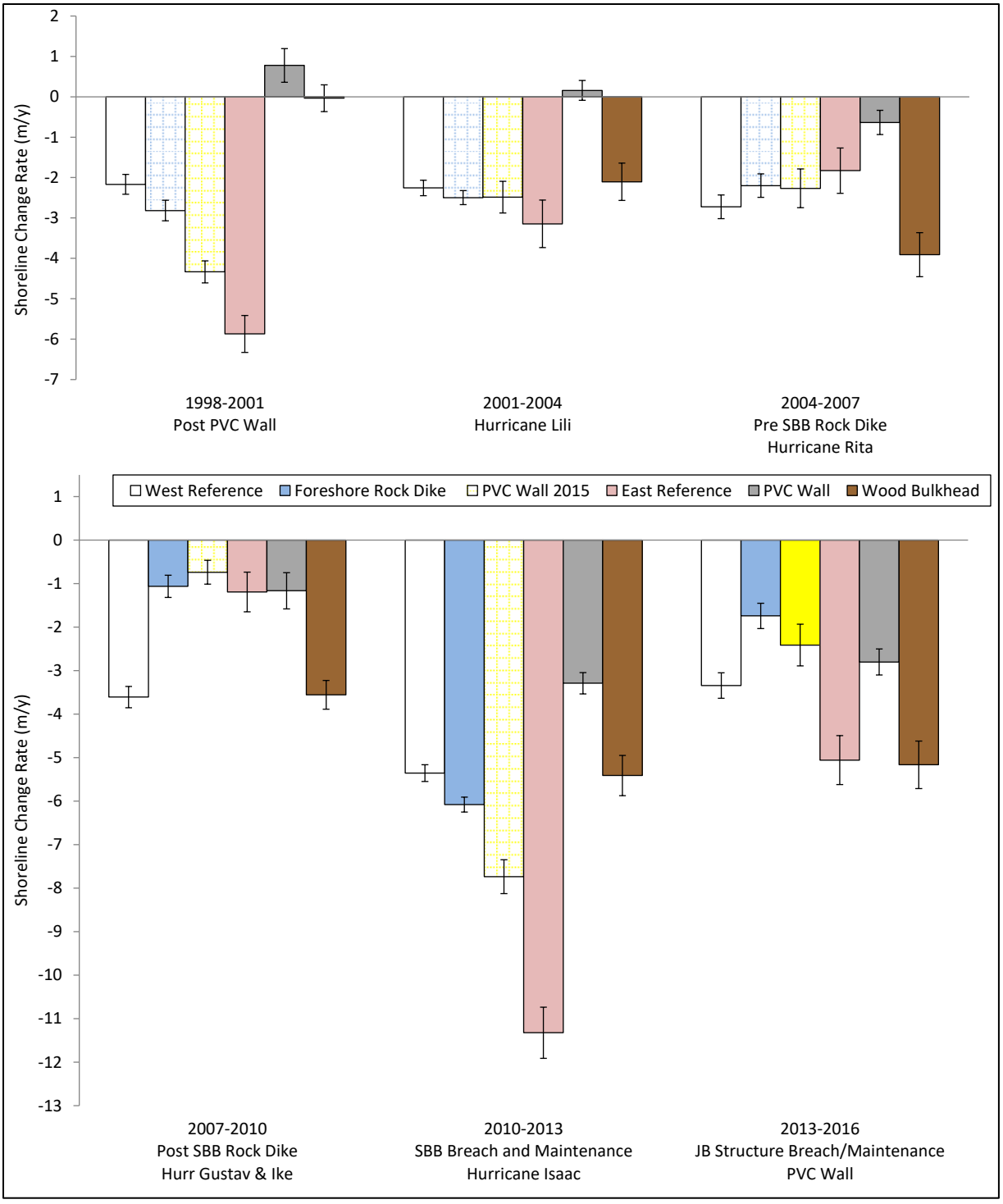

Figure 4. Intervals of shoreline change rates were calculated from shoreline mapping conducted along protected and unprotected shoreline of East Cote Blanche Bay within the TV-04 project area from 1998-2013.

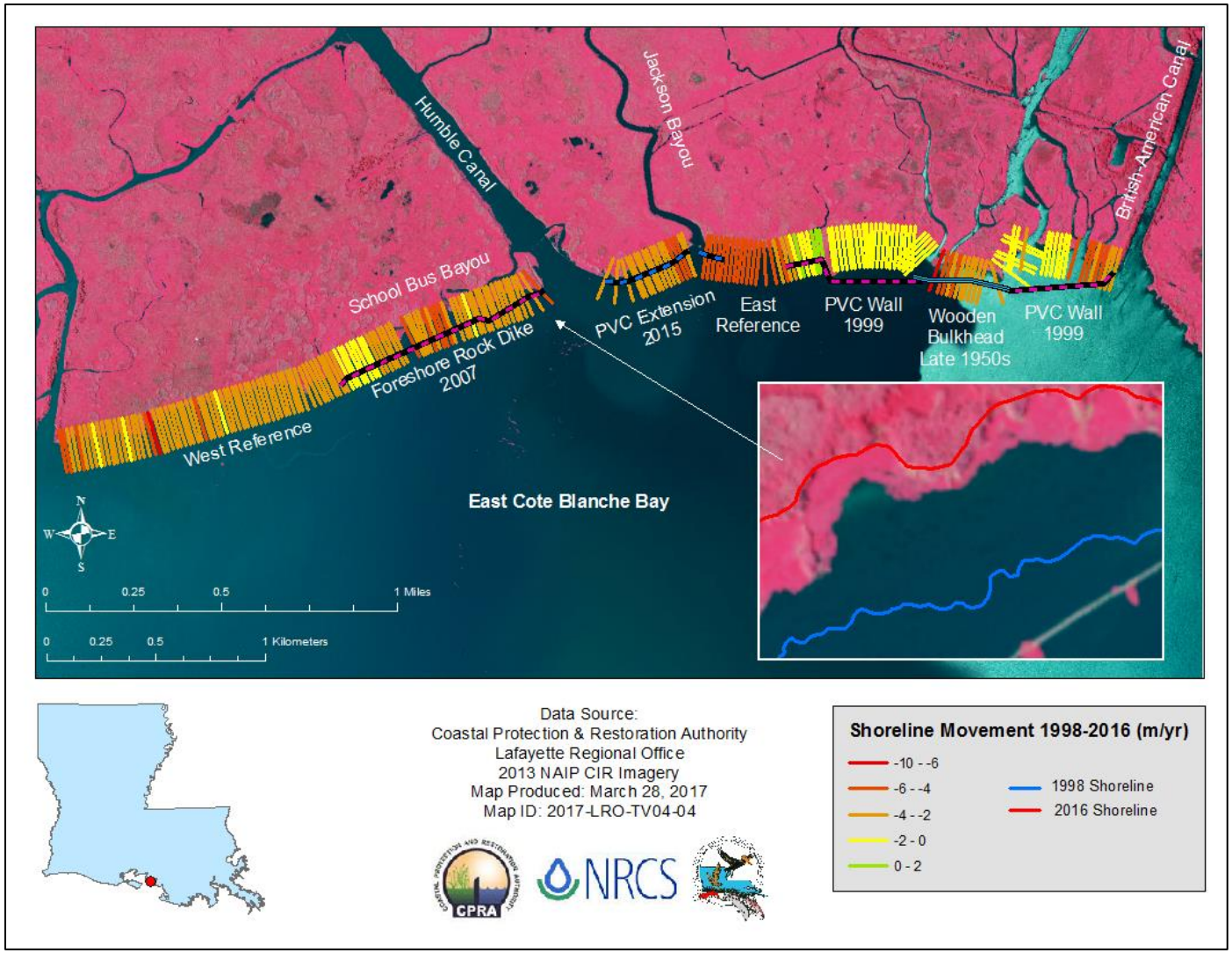

Figure 5. Cote Blanche Hydrologic Restoration (TV-04) shoreline change over the life of the project (1998-2016). The Wooden Bulkhead was a pre-existing structure constructed in the late 1950s. The PVC walls to the east were installed during project construction in 1999. The School Bus Bayou Foreshore Rock Dike was constructed in 2007. The PVC wall to the west was constructed in 2015.

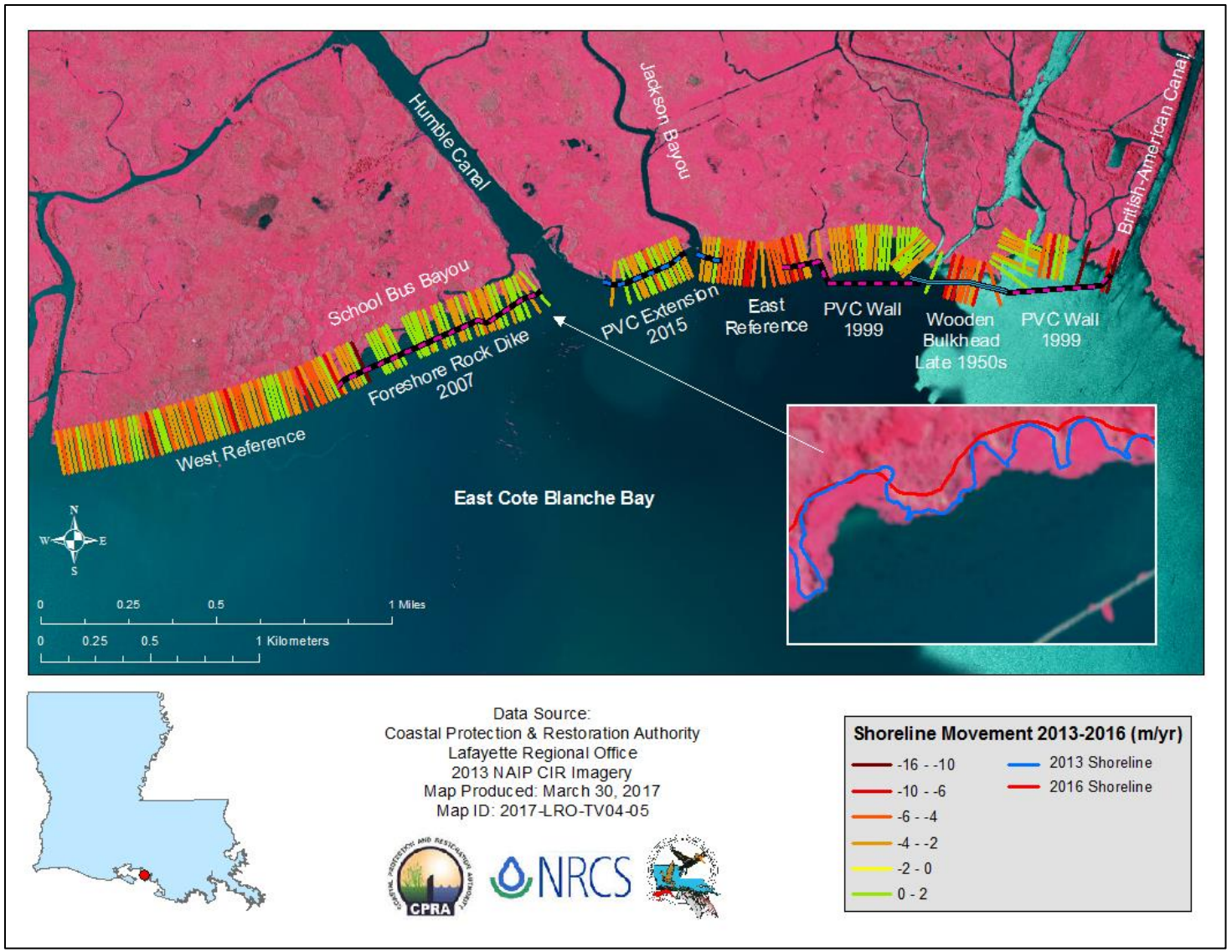

Figure 6. Cote Blanche Hydrologic Restoration (TV-04) shoreline change from 2013 to 2016. A breach had formed around the Jackson Bayou structure in 2012. The breach was repaired and a new PVC foreshore wall was added from Jackson Bayou to Humble Canal.

Land Area Change

Since construction, the TV-04 project area has gained approximately 512 acres of land (1997-2015; table 3 figures 7-9). Early in the project, as many as 1765 acres were lost to Hurricane Lili (2002; Figure 8). Between December 2002 and December 2015, the project area saw 1228 acres of land gain (Figures 9-11). The land gain occurred in the interior marsh where shallow ponds filled in with vegetation and the marsh became less fragmented and while erosion along the edge continued. The ponds created by Hurricane Lili still persist in the northern part of the project area (Figures 8-11).

A recent USGS study showed slowing landloss coastwide including in the Teche Vermilion basin (Couvillion et al 2017). Over the TV-04 project timeframe, land loss continued in the Teche Vermilion basin at a rate of -0.07%/yr while the TV-04 project area saw gains of +0.13%/yr. Land gain can be attributed to the TV-04 project features and the positive effect of slowing tidal exchange and reducing the export of organic marsh material.

Table 3. Land area and land area change rates of TV-04 were compiled from high resolution imagery (1:24,000) collected by the USGS-National Wetlands Research Center pre- (1997) and post-construction (2002, 2009, 2015). Initial construction (low-level weirs and PVC wall) was completed in January 1999; Hurricane Lili occurred in October 2002; School Bus Bayou structures (low-level weirs and foreshore rock dike) were added in September 2007; Hurricane Gustav occurred in September 2008; maintenance was performed on the School Bus Bayou structures in 2011; the Bayou Jackson structure was breached in 2012; and, the Bayou Jackson structures were repaired and additional PVC wall was installed by June 2015. Historical Change Rate for TV-04 was compiled from Britsch and Kemp 1990 (1956, 1978, 1988) and TV-04 1996. Teche/Vermilion Basin land area change rates were adapted from Couvillion et al. 2017 to provide a basin-wide context and comparison.

	Land Area	
Date	Acres	Percent
TV-04 Project Area		
January 1997	26,076	83.4
December 2002	25,360	82.0
December 2009	25,731	83.2
October 2012	25,986	84.1
December 2015	26,588	85.9
Post Construction Change Rate (1997-2015, /y)	+42.9	+0.13
Historical Change Rate (1957-1996, /y)[1]	-83.9	-0.27
Teche/Vermilion (TV) Basin[2]		
Post Construction Change Rate (1998-2015, /y)	N/A	-0.02
Historical Change Rate (1957-1998, /y)	N/A	-0.11

[1] Britsch and Kemp 1990

[2] Adapted from Couvillion et al. 2017

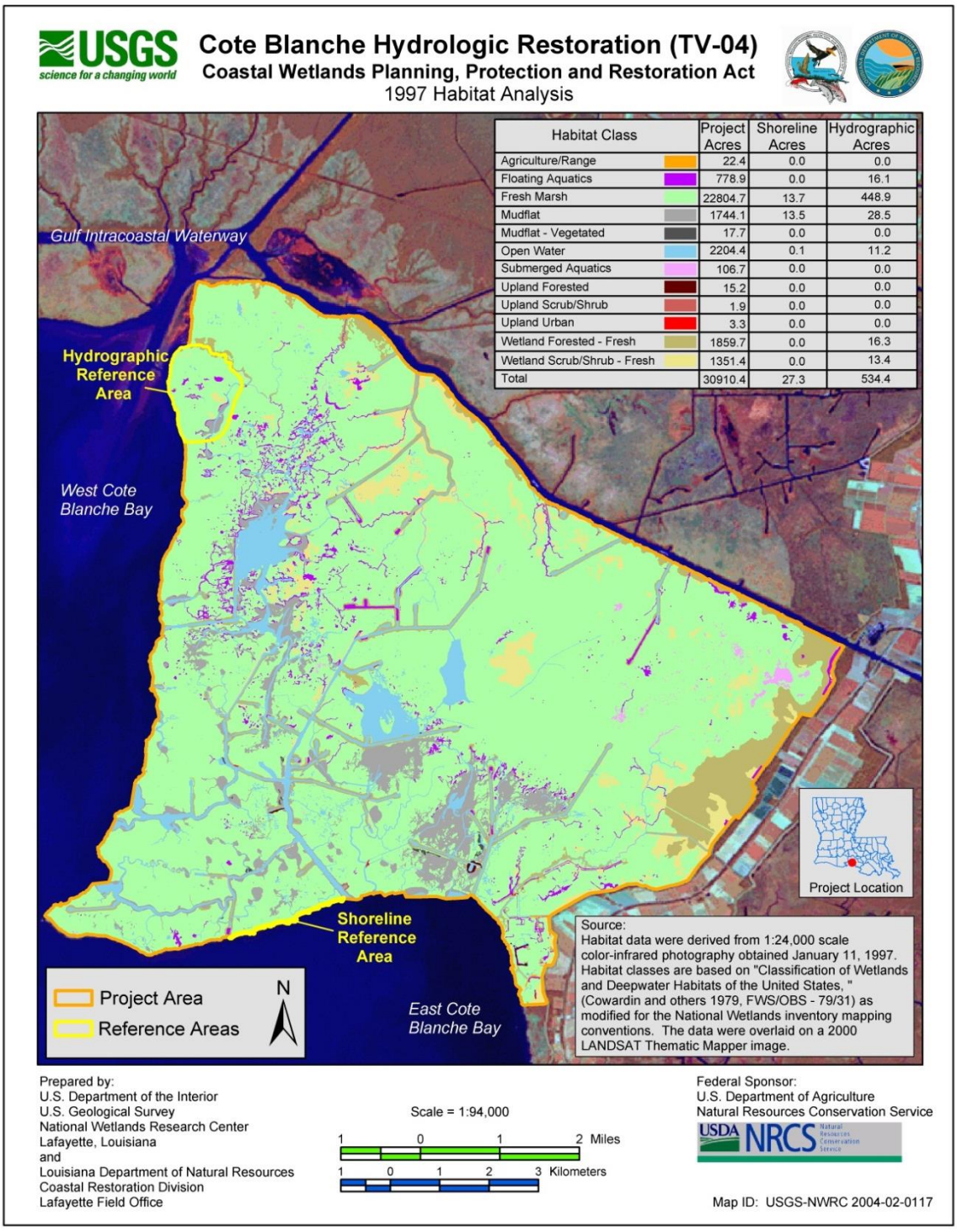

Figure 7. Cote Blanche Hydrologic Restoration (TV-04) 1997 GIS habitat analysis from photography taken January 1997. Open water, floating aquatics, mudflat and submerged aquatics categories are considered to be water for comparison to other maps.

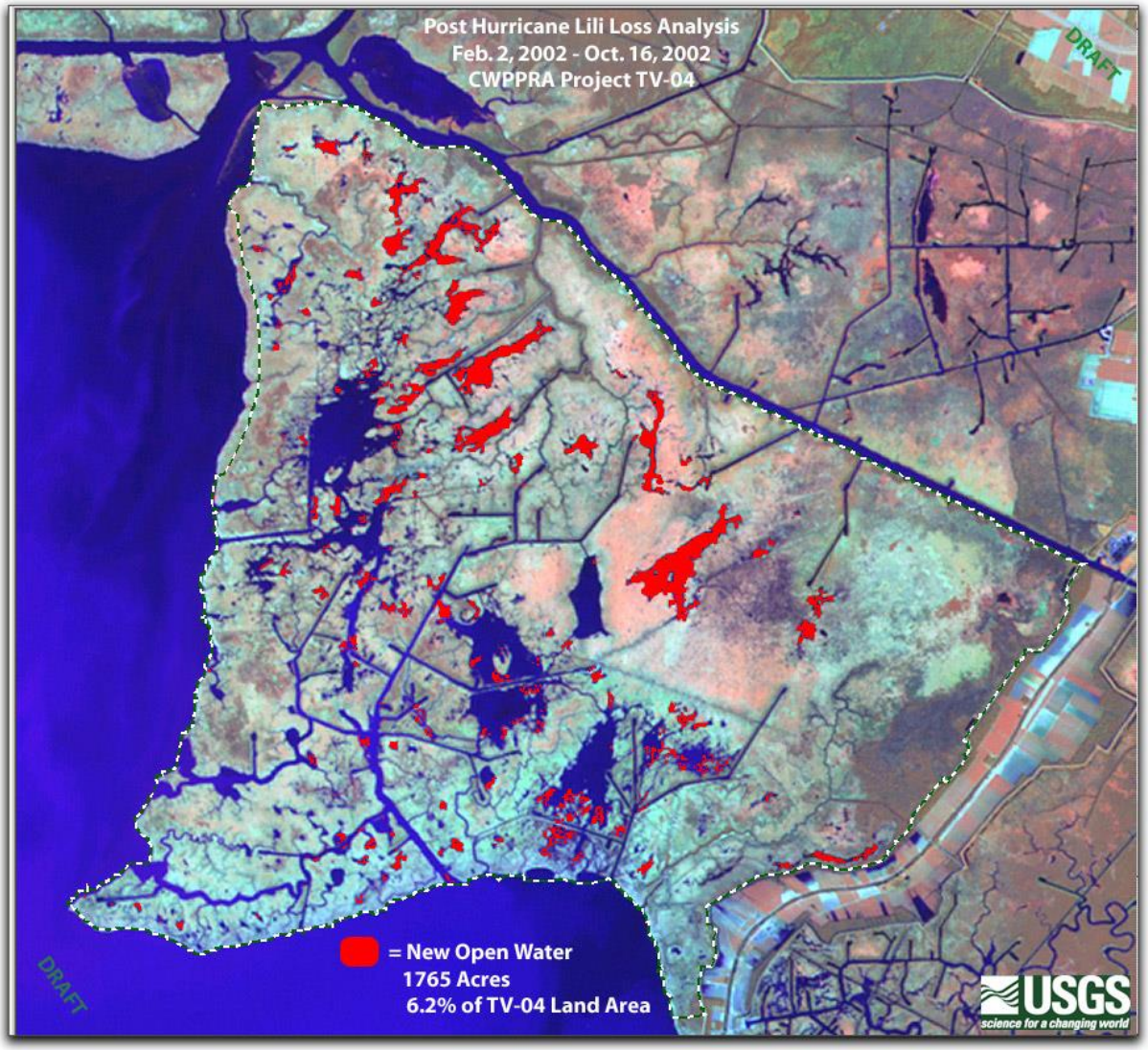

Figure 8. Land to Water change analysis (February 2002 – October 2002) resulting from Hurricane Lili (10/3/02). Satellite imagery and analysis provided by U. S. Geological Survey.

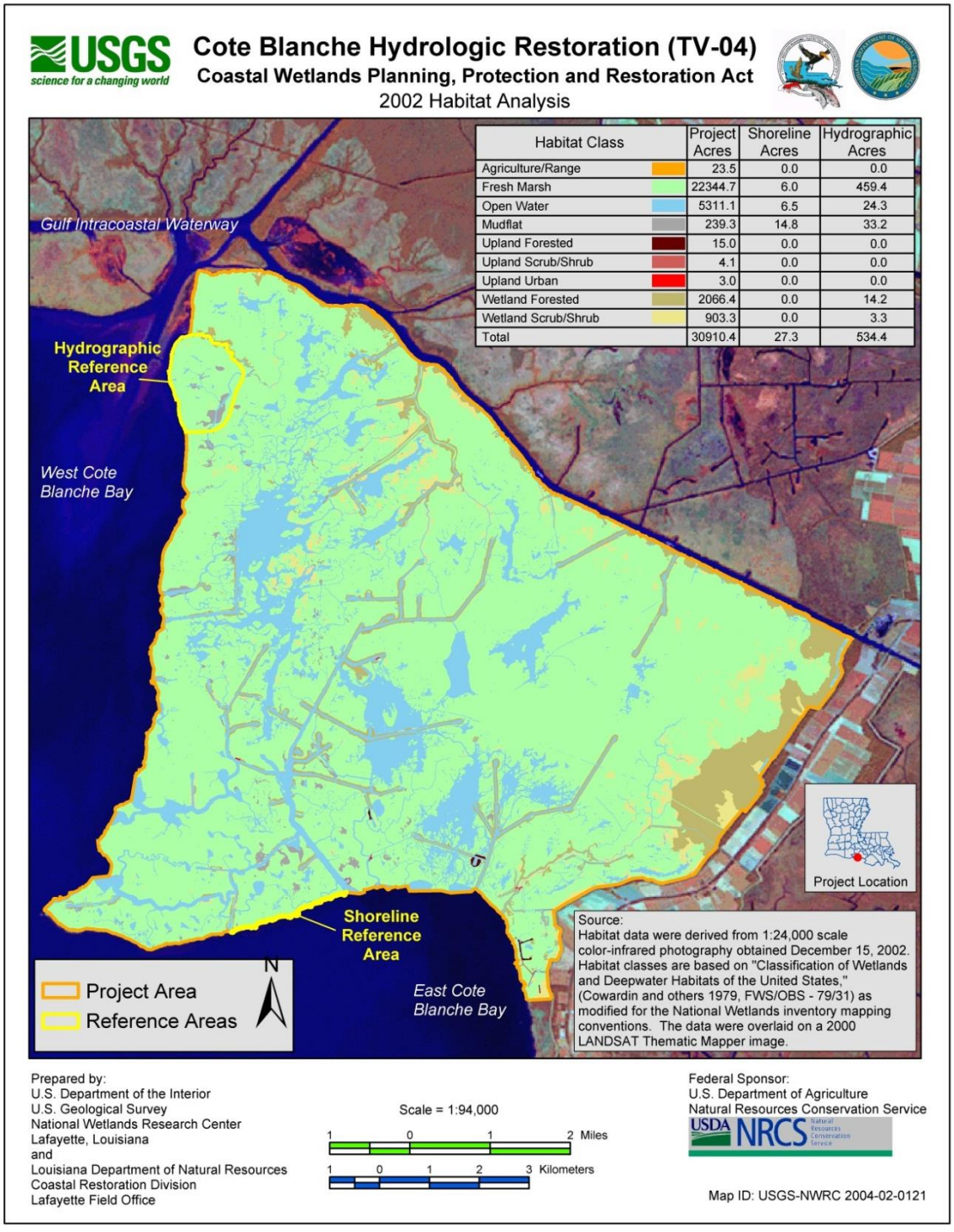

Figure 9. Cote Blanche Hydrologic Restoration (TV-04) 2002 GIS habitat analysis from photography taken December 2002 (after Hurricane Lili). Open water and mudflat categories are considered to be water for comparison to other maps.

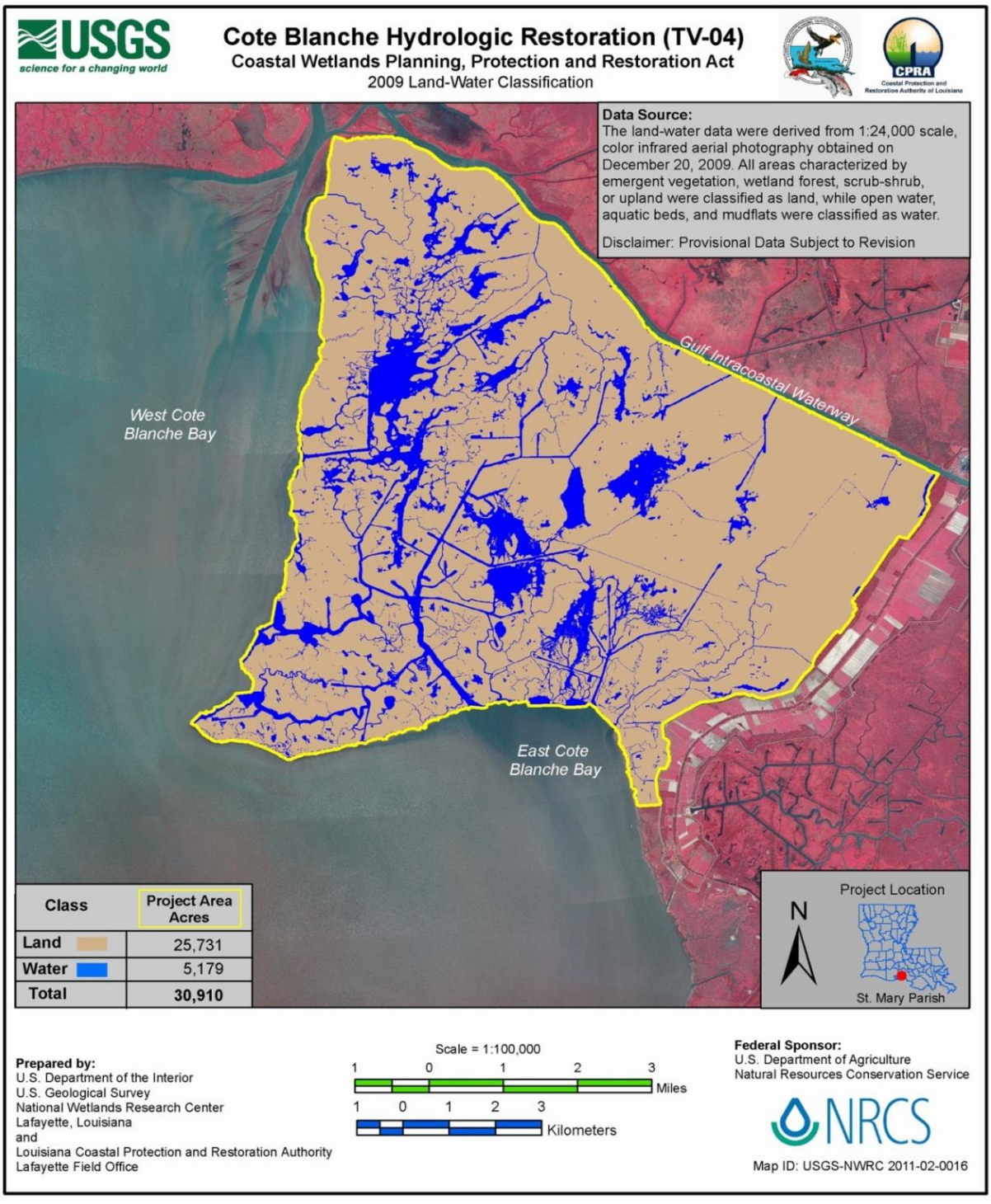

Figure 10. Cote Blanche Hydrologic Restoration (TV-04) 2009 land and water analysis from photography taken December 2009.

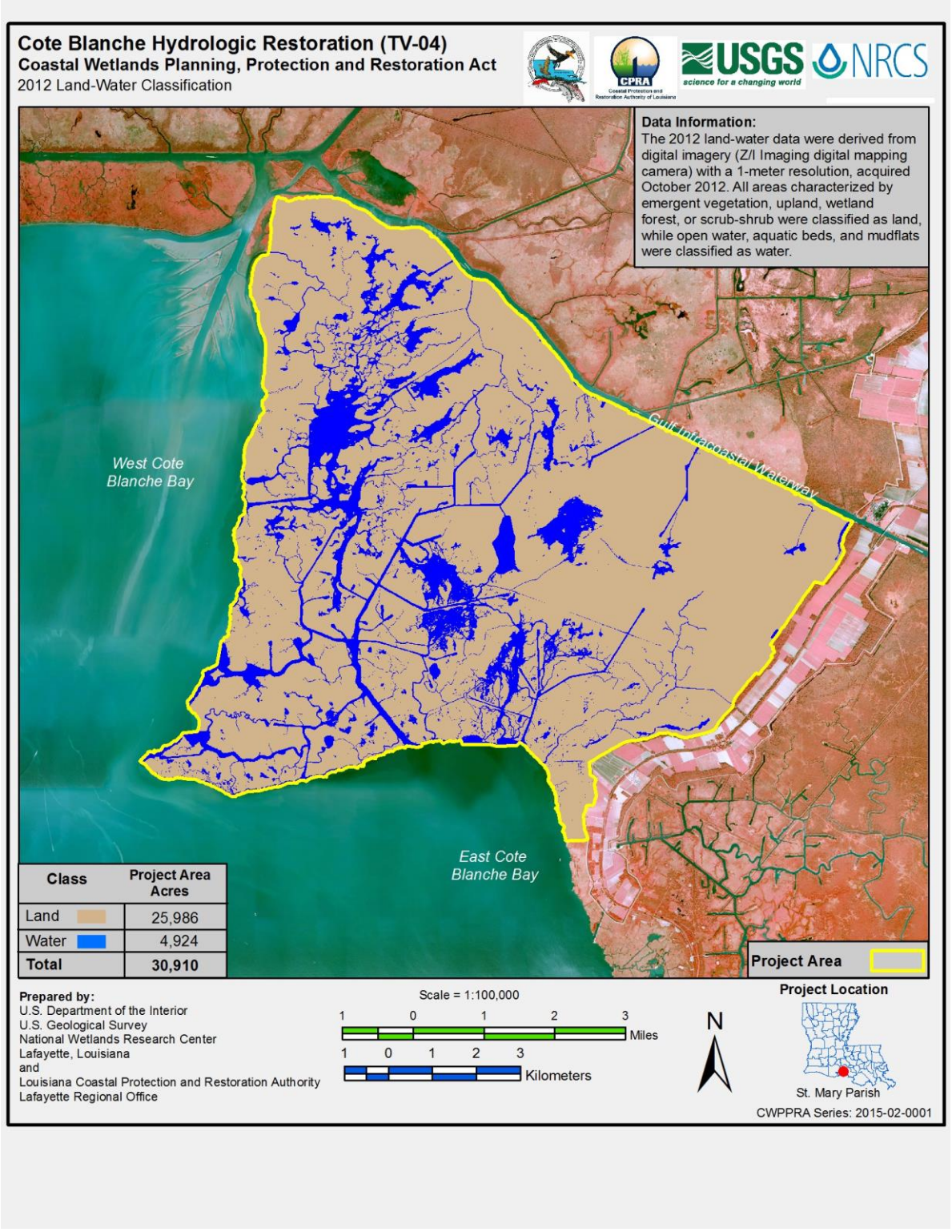

Figure 11. Cote Blanche Hydrologic Restoration (TV-04) 2012 land and water analysis from photography taken October 2012.

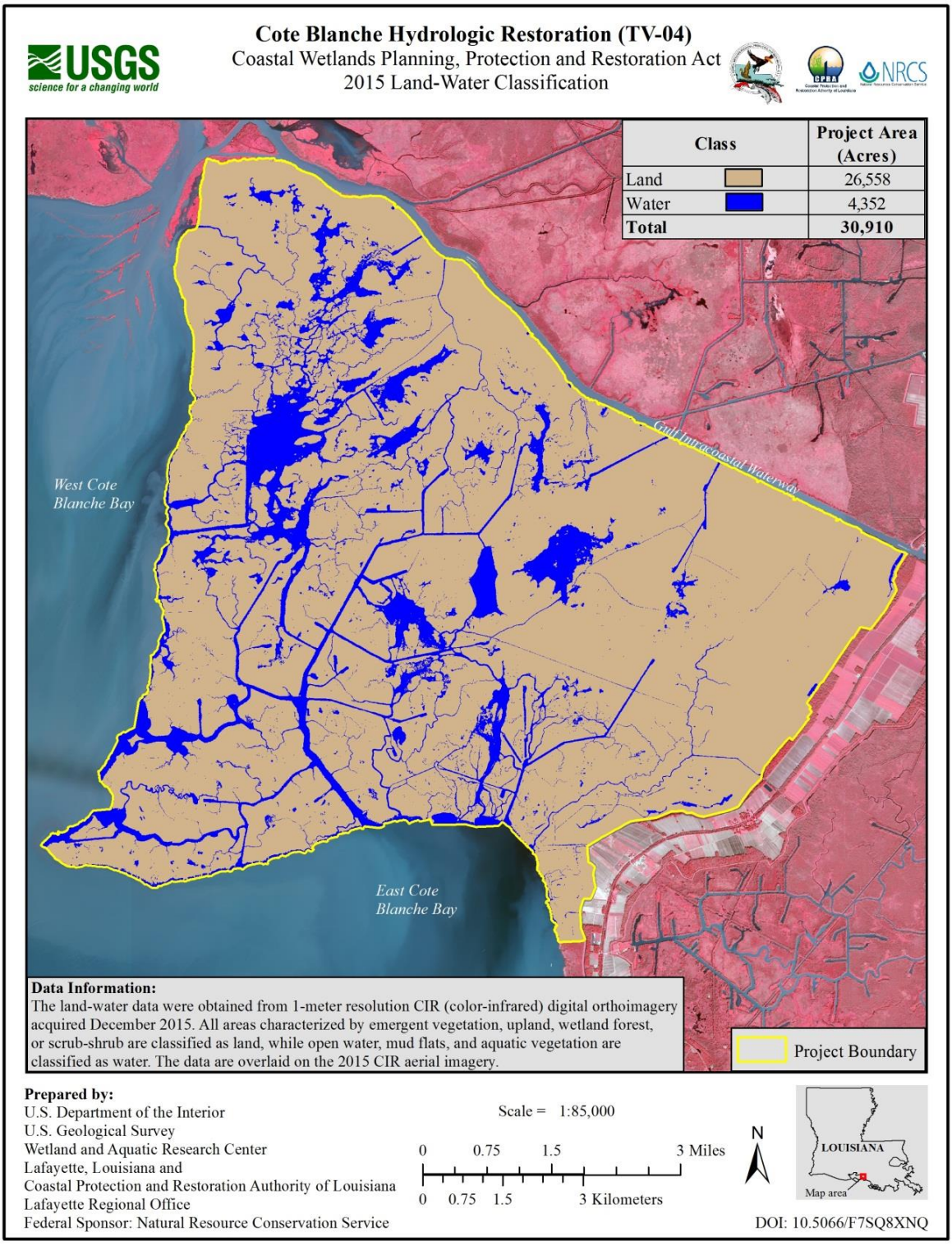

Figure 12. Cote Blanche Hydrologic Restoration (TV-04) 2015 land and water analysis from photography taken December 2015.

V. Conclusions

a. Project Effectiveness

Cote Blanche Hydrologic Restoration (TV-04) project has been successful at achieving the specific goals of decreasing water level variability within the project area and decreasing the rate of marsh loss. The reduced tidal exchange via the low-level weirs across the large pipeline canal openings is decreasing daily hydraulic energy which reduces export of vulnerable organic soils and allows the marsh interior to recuperate following storm-surge disturbances.

The Cote Blanche Bay shoreline continues to erode and has breached project weirs twice. When the weirs are circumvented by water, project effects also erode, allowing for higher tidal exchange and more export of organic marsh material.

Over the life of the project, the TV-04 project area has gained over 500 acres of marsh land. Prior to the project, the area was losing land. The region continues to lose land, albeit more slowly than it did during the second half of the last century.

Shoreline protection measures have reduced erosion relative to unprotected shorelines but the effectiveness of shoreline protection measures decreases over time and due to hurricanes and rafting of floating vegetation.

b. Recommended Improvements

At present, components of the Cote Blanche Hydrologic Restoration Project are in need of significant repair. A substantial amount of maintenance will be necessary to keep the project functioning as it has over the years.

The banks adjacent to the wingwalls of the weir structures are threatening to breach. Water control structures should be protected from bypass breaches by hardening the bank at each wing wall with rock.

The shoreline protection features should be constructed closer to the existing shoreline to reduce wind fetch. Dredged materials for access canals should be placed between the foreshore structure and shoreline. Alternatives tested for low weight-bearing soils in the Non-rock Alternatives to Shoreline Protection Demonstration project (LA-0016), the light-weight aggregate core (LWAC) breakwater in the Rockefeller Gulf Shoreline Stabilization project (ME-0018), and the OysterBreak from the Bio-engineered Oyster Reef Demonstration (LA-0008) should be investigated for use along ECBB.

c. Lessons Learned

Water control structures should be protected from bypass breaches by hardening the bank at each wingwall with rock. Rock should be placed at an elevation that allows extremely high tidal events to pass around the structure without scouring the banks.

Stainless steel cable attached to driven timber piles continue to perform better than the rails that were installed on the original structures. This method should be considered during construction of similar structures in harsh environments such as this in the future.

PVC shoreline protection walls can experience scour at the foot of the wall where wave action impacting the face of the wall causes the wave to move upward and subsequently fall creating wave downfall pressures at the base. If left unprotected, the scour can propagate and eventually undermine the structure.

d. End of Project Life

If project features are not maintained, it is reasonable to expect that continuing erosion along the East Cote Blanche Bay shoreline will cause the low lying weir structures to be breached, rendering them less effective and making the interior marshes more vulnerable to land loss associated with the export of organic sediments. Continued maintenance of critical project features including the weirs and the shoreline adjacent to the weirs, is recommended. Shoreline protection elements that are currently far from the shoreline should be replaced with protection closer to the shoreline and in the areas of existing weirs.

If weirs are not to be maintained, leaving them in place would still provide some benefit in that they would continue to constrict the channel. Complete removal of weir structures is not recommended.

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Appendix A
Photographs

Photo 1--Mud Bayou structure

Photo 2—Cable attached to broken pile and sign at Humble F Canal structure

Photo 3—Bayou Long structure

Photo 4--Bayou Carlin Structure

Photo 5--Humble Canal structure

Photo 6—Humble Canal structure east side showing missing pile cap and disconnected cable

Photo 7--rock on east side of Humble Canal

Photo 8—area of submerged School Bus Bayou dike

Photo 9—western weir at School Bus Bayou

Photo 10—eastern weir at School Bus Bayou

Photo 11—Jackson Bayou structure (and piece of new PVC wall)

Photo 12—breach on eastern end of Jackson Bayou Structure

Photo 13—British American Canal Structure

Photo 14—rock along British American Canal

Photo 15—Typical section of old PVC wall

Photo 16—typical damage on new PVC wall

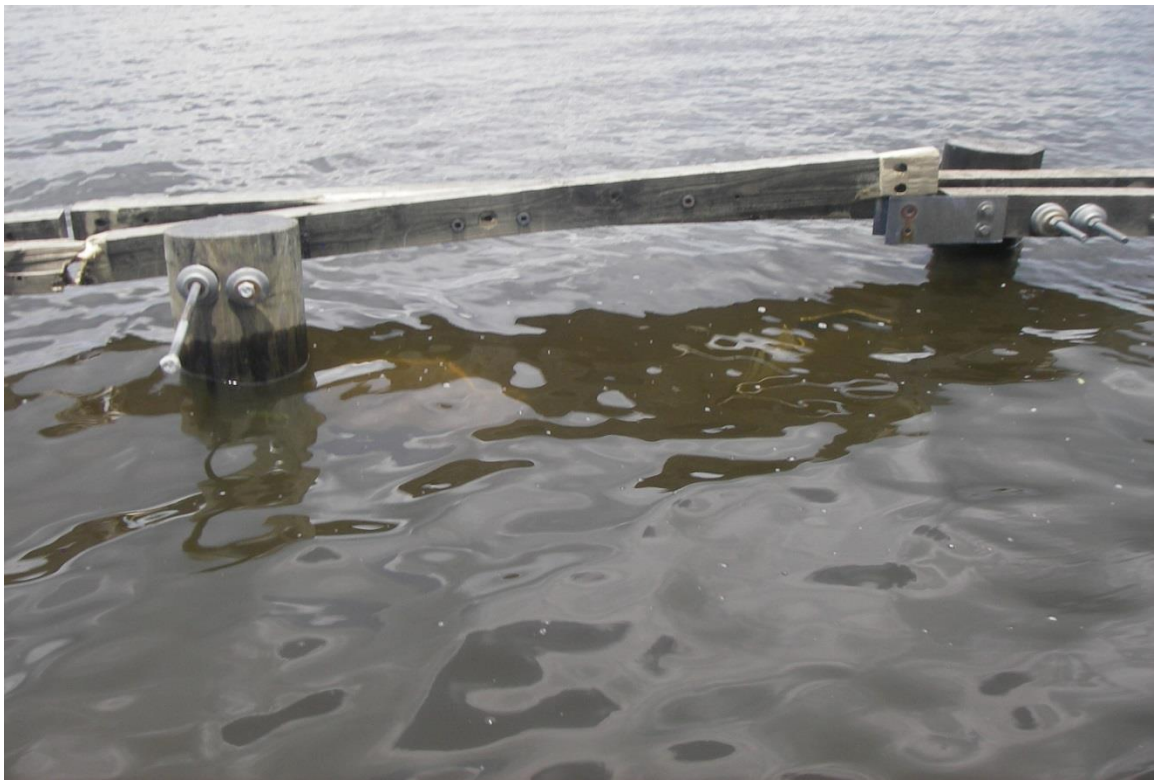


Photo 17—typical damage on new PVC wall

Photo 18—typical rust on sheet pile structures

Appendix B
Three Year Budget Projection

COTE BLANCHE/ TV-04 / PPL 3

Three-Year Operations & Maintenance Budgets 07/01/2017 - 06/30/2020

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Pat Landry	*Stan Aucoin*	*NRCS*	*Stan Aucoin*

	2017/2018 (-18)	2018/2019 (-19)	2019/2020 (-20)
Maintenance Inspection	$ 7,269.00	$ 7,487.00	$ 7,712.00
Nav. Aid Inspections	$ 10,000.00	$ 10,000.00	$ 10,000.00
State Administration			
Federal Administration			
Maintenance/Rehabilitation			

17/18 Description:

E&D	
Construction	
Construction Oversight	
Sub Total - Maint. And Rehab.	$ -

18/19 Description:

E&D	$ -
Construction	
Construction Oversight	
Sub Total - Maint. And Rehab.	$ -

19/20 Description:

E&D	
Construction	
Construction Oversight	
Sub Total - Maint. And Rehab.	$ -

	2017/2018 (-18)	2018/2019 (-19)	2019/2020 (-20)
Total O&M Budgets	**$ 17,269.00**	**$ 17,487.00**	**$ 17,712.00**

O &M Budget (3 yr Total)	**$ 52,468.00**
Unexpended O & M Budget	**$ 1,391,392.00**
Remaining O & M Budget (Projected)	**$ 1,338,924.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

COTE BLANCHE HR / PROJECT NO. TV-04 / PPL NO. 3 / 2017/2018

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$7,269.00	**$7,269.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Nav. Aid Inspections Contract	LUMP	1	$10,000.00	**$10,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

STATE Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Creation Topo & Borrow Bathymetry	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Dike	0	0.0	0	$0.00	$0.00
Bank Paving	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency		LUMP	0	$0.00	$0.00
General Structure Maintenance (25%)		LUMP	0	$0.00	$0.00
Vegetative Plantings		LUMP	0	$0.00	$0.00
OTHER		LUMP	0	$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$17,269.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

COTE BLANCHE HR / PROJECT NO. TV-04 / PPL NO. 3 / 2018/2019

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$7,487.00	**$7,487.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Nav. Aid Inspections Contract	LUMP	1	$10,000.00	**$10,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Dike	0	0.0	0	$0.00	$0.00
Bank Paving	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency		LUMP	0	$0.00	$0.00
General Structure Maintenance (25%)		LUMP	0	$0.00	$0.00
Vegetative Plantings		LUMP	0	$0.00	$0.00
OTHER		LUMP	0	$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$17,487.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

COTE BLANCHE HR / PROJECT NO. TV-04 / PPL NO. 3 / 2019/2020

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$7,712.00	**$7,712.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Nav. Aid Inspections Contract	LUMP	1	$10,000.00	**$10,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

STATE Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Dike	0	0.0	0	$0.00	$0.00
Bank Paving	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency		LUMP	0	$0.00	$0.00
General Structure Maintenance (25%)		LUMP	0	$0.00	$0.00
Vegetative Plantings		LUMP	0	$0.00	$0.00
OTHER		LUMP	0	$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$17,712.00**

Appendix C
Field Inspection Forms

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: June 26, 2017 Time:

Structure No. 1 Mud Bayou

Inspector(s):Stan Aucoin and Darrell Pontiff(CPRA)
Nick McCoy (NRCS) and Rick Hartman (NOAA)

Structure Description: Fixed crest weir, rock paving on bank

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy Skies and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			1	Structure in good condition and functioning as intended. Rust continues to be monitored. Staff gauges need to be replaced.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles	good				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	Good			1	Railings have been replaced with stainless steel cables
Signage /Supports	good				The north danger sign is missing and will not be replaced.
Rip Rap (fill)	good				
Earthen Embankment	Fair			1	Erosion of the bank on the South side of the structure is becoming apparent.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: June 26, 2017 Time:

Structure No. 2 Humble F Canal

Inspector(s):Stan Aucoin and Darrell Pontiff(CPRA)
Nick McCoy (NRCS) and Rick Hartman (NOAA)

Structure Description: Fixed crest weir, rock paving on bank

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy Skies and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			2, 18	Structure in good condition. Some slight rusting of pile caps.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles	good				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	Good			2	Stainless Steel Cables are present and functioning.
Signage /Supports	good			2	The piling and arrow sign replaced during last maintenance on north side is missing.
Rip Rap (fill)	good				Rock on end of structure is stable and functioning as intended.
Earthen Embankment	N/A				The bay shore in front of the structure continues to erode such that the structure is now near the bayshore.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: June 26, 2017 Time:

Structure No. 3 Bayou Long

Inspector(s):Stan Aucoin and Darrell Pontiff(CPRA)
Nick McCoy (NRCS) and Rick Hartman (NOAA)

Structure Description: Fixed crest weir

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy Skies and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			3, 18	Rusting on steel sheet piles will continue to be monitored.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles	good				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	Good			3	The railings on the structure have been replaced with stainless steel cables.
Signage /Supports	good			3	Signage is in place
Rip Rap (fill)	good				
Earthen Embankment	N/A				

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: June 26, 2017 Time:

Structure No. 4 Bayou Carlin

Inspector(s):Stan Aucoin and Darrell Pontiff(CPRA)
Nick McCoy (NRCS) and Rick Hartman (NOAA)

Structure Description: Fixed crest weir

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy Skies and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			4	Structure is in fair to good post-construction condition. Hyacinths prevented a close up inspection of the structure. Sheet piling and stainless steel cables were in place.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles	good				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	good			4	present and functioning
Rip Rap (fill)	N/A				
Earthen Embankment	N/A				

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: June 26, 2017 Time:

Structure No. 5 Humble Canal

Inspector(s):Stan Aucoin and Darrell Pontiff(CPRA)
Nick McCoy (NRCS) and Rick Hartman (NOAA)

Structure Description: Fixed crest weir, rock on banks and canal

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy Skies and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			5-6, 18	Rust continues to worsen and will be monitored. Rusting on sheet pile will continue to be monitored. No immediate action needed.
Cables	Good			5-6	Railings have been replaced with stainless steel cables. The stainless steel cables are functioning except for the area which was connected to the pile cap.
Stop Logs	N/A				
Hardware	fair				
Timber Piles	N/A				
Timber Wales	N/A				
Galv. Pile Caps	Fair			6	Pile Cap on East Side is Missing
USCG Lights	good			5	Present and functioning
Signage /Supports	good			5	Present and functioning
Rip Rap (fill)	good			7	Some settlement but still in good condition
Earthen Embankment	N/A				

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: June 26, 2017 Time:

Structure No. 6 Jackson Bayou

Inspector(s):Stan Aucoin and Darrell Pontiff(CPRA)
Nick McCoy (NRCS) and Rick Hartman (NOAA)

Structure Description: Fixed crest weir

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy Skies and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			11, 18	Some slight rusting of pile caps.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles					
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	good			11	Present and functioning
Rip Rap (fill)	good			12	The rock from original construction at the end of the PVC wall was salvaged and moved to the eastern end of the Jackson Bayou structure to fill a gap forming around the structure. The stone hasn't fully closed the gap but improved the situation slightly. Additional stone would be needed to completely shore up this gap.
Earthen Embankment	N/A				The bankline has eroded past the structure wingwalls. Erosion particularly on the western side is worsening.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: June 26, 2017 Time:

Structure No. School Bus Bayou SP

Inspector(s):Stan Aucoin and Darrell Pontiff(CPRA)
Nick McCoy (NRCS) and Rick Hartman (NOAA)

Structure Description: Foreshore Rock Dike & Weirs

Water Level Inside: Outside:

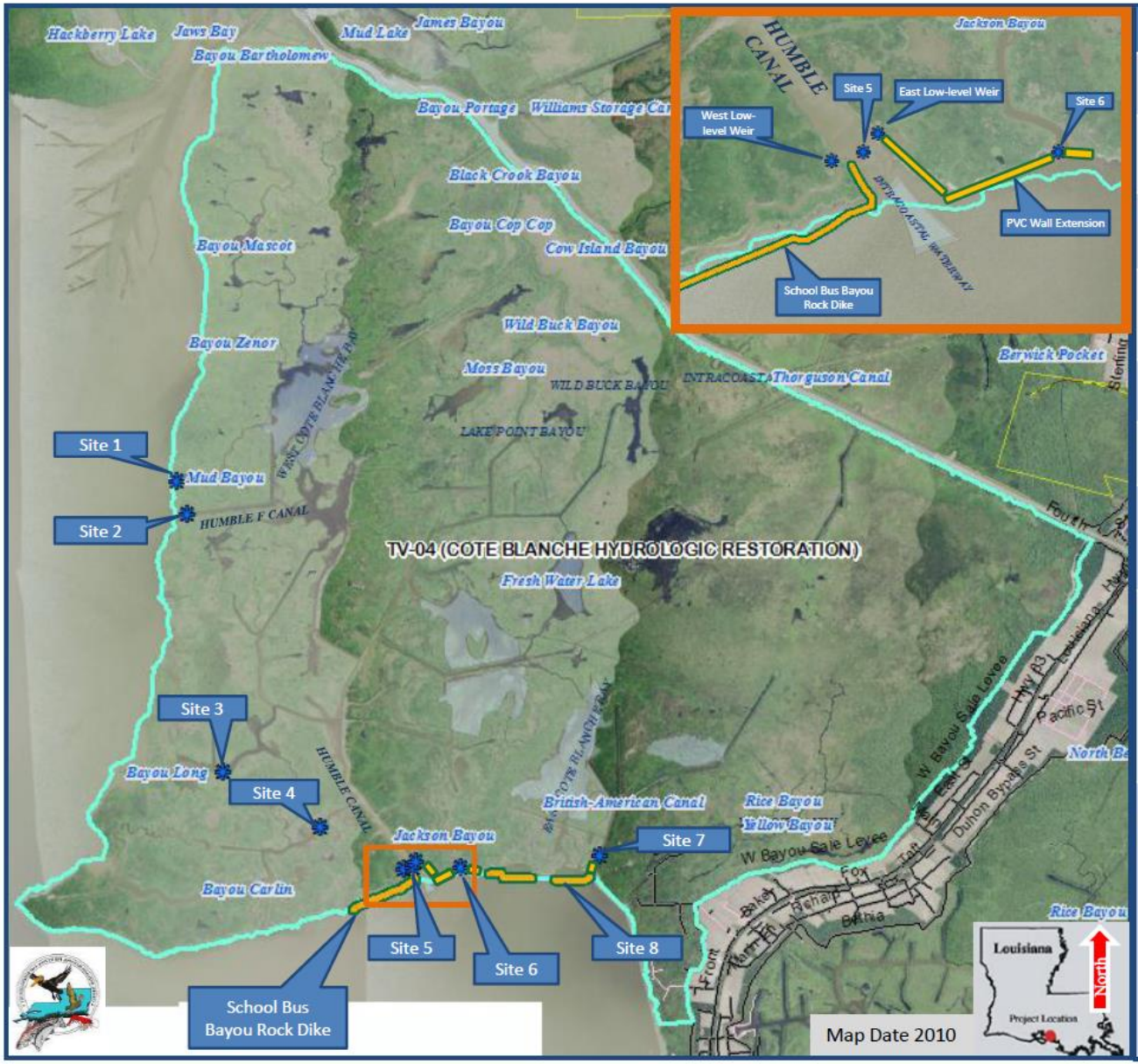
Type of Inspection: Annual

Weather Conditions: Cloudy Skies and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Rip Rap (fill) School Bus Bayou	Good			8	The dike was completely submerged due to high tides and unable to be inspected. Rock on the eastern intersection of SBB and Humble Canal is in place and stable; however, no rock was found on the western side.
Low Level Weirs	Good			9&10	
Signage /Supports	Good			9-10	Signage is intact
Hardware	N/A				
Timber Piles	Good				
Pile Caps	Good				

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

Appendix D
Constructed Project Features Map



Location	Description
Site 1	Mud Bayou Fixed Crested Weir
Site 2	Humble F Canal Fixed Crested Weir
Site 3	Bayou Long Fixed Crested Weir
Site 4	Bayou Carlin Fixed Crested Weir
Site 5	Humble Canal Fixed Crested Weir
Site 6	Jackson Bayou Fixed Crested Weir
Site 7	British-American Canal Fixed Crested Weir
Site 8	PVC Sheet Pile Wall & Extension (Existing Wooden wall between original PVC segments)
School Bus Bayou Project	Rock Breakwater along bank of Cote Blanche Bay West of Humble Canal, Low-level Weirs at Intersection of School Bus Bayou and Humble Canal (See Call Out)