State of Louisiana

Coastal Protection and Restoration Authority (CPRA)

2014 Operations, Maintenance, and Monitoring Report

for

Cote Blanche Hydrologic Restoration

State Project Number TV-04
Priority Project List 3

June 2014
St. Mary Parish

Prepared by:

Maggie Hawkins
and
Stan Aucoin, Engineering Tech

CPRA - Operations Division
Lafayette Regional Office
Abdalla Hall, Room 201
635 Cajundome Boulevard
Lafayette, LA 70506

Suggested Citation:

Hawkins, M. and S. Aucoin 2014. *2014 Operations, Maintenance, and Monitoring Report for Cote Blanche Hydrologic Restoration (TV-04),* Coastal Protection and Restoration Authority of Louisiana, Lafayette, Louisiana. 59 pp and Appendices.

2014 Operations Maintenance and Monitoring Report
For
Cote Blanche Hydrologic Restoration (TV-04)

Table of Contents

Preface

This report includes monitoring data collected through December 2013, and annual Maintenance Inspections through May 2014.

The 2014 report is the 4th report in a series of reports. 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 (2005-2013) 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 05, 2014.

	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

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.

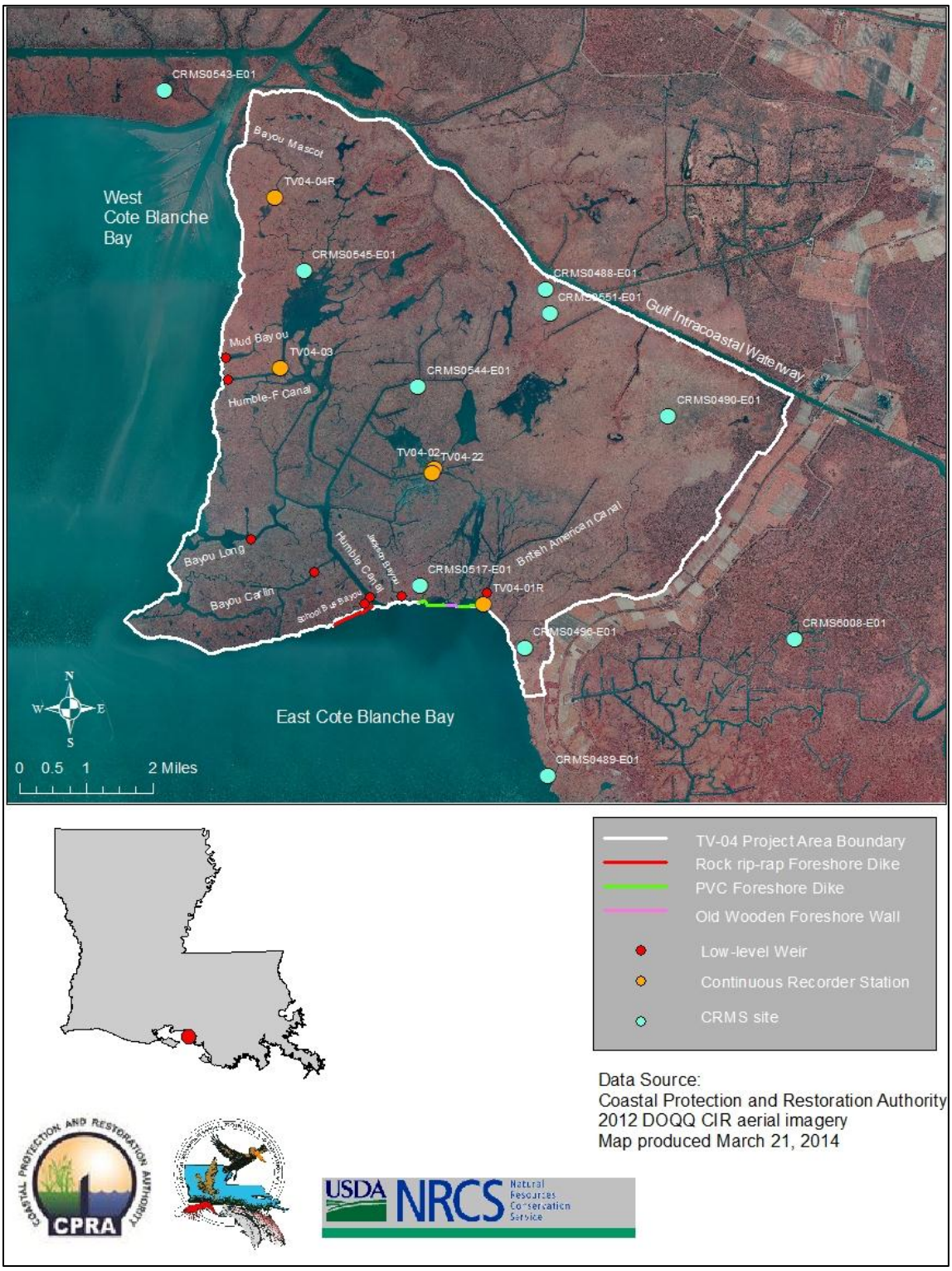


Figure 1. Cote Blanche Hydrologic Restoration (TV-04) project area boundary and features.

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 April 23, 2014 under partly cloudy skies and mild temperatures. In attendance were Stan Aucoin, Dion Broussard & Maggie Hawkins of CPRA; Cindy Steyer of NRCS; and John Foret of NOAA for inspections of 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 still appears to be holding up fairly well. Rust on the sheet piles and the pile cap continues but has not gotten significantly worse. The railing continues to erode and will soon become an issue. The north danger sign is missing and will not be replaced. Staff gauges no longer functional. (Photos: Appendix B, Photo 1)

Site 2—Humble F Canal

The piling and arrow sign replaced during the last maintenance event (north side) is missing. Sheet piles and rocks on the end of the structure are stable and functioning as intended. Rust on the sheet piles will be monitored. Damaged sections of railing that were replaced by driving timber pilings and attaching stainless steel cables in the sections where the railing was damaged or missing is in excellent shape. The bayshore in front of this structure has eroded considerably over the years. (Photos: Appendix B, Photo 2)

Site 3—Bayou Long

Pilings and SS cables that replaced the railing on the structure is working well, however sections of railing that were not replaced in this manner have rusted to the point of collapse and have become an issue. Rusting on the sheet piles will be monitored. (Photos: Appendix B, Photo 3)

Site 4—Bayou Carlin

The structure is still in excellent post-construction condition. The Bayou Carlin structure and signage are stable. The coating on the sheet piles is rusting and will be monitored as the others. (Photos: Appendix B, Photo 4)

Site 5—Humble Canal

Rail damage on the west end of the structure that was replaced with pilings and SS cables is functioning as intended. Rock that was placed to extend the keyway closure has settled but is in otherwise good shape. Signage all stable. (Photos: Appendix B, Photos 5-7)

School Bus Bayou

No significant additional settlement of the rock dike was noticed. Water levels were very high, approximately +3.0. Signage along the bay shore is intact. Due to the high water level, no rock was found on the western end of School Bus Bayou at its intersection with Humble Canal, however it is assumed to still be there. Signage at the crossings is ok. (Photos: Appendix B, Photos 8-10)

Site 6—Jackson Bayou

The shoreline on the eastern side of the structure has now eroded all the way through between the rock and the structure. This gap is now approximately 60 feet wide and about 2 ½ feet deep. This area will be addressed in the maintenance event scheduled for the summer of 2014. Rock placed near the western end of the PVC wall will be picked up and placed in this

area to try to stabilize the shoreline. The coating on the sheet piles continues to rust as on the other structures and will be monitored. (Photos: Appendix B, Photos 11-12)

Site 7—British American Canal

Rust on the sheet piles will be monitored as well. Signage is in excellent shape. Rock along the shoreline between the structure and the PVC wall is also in excellent shape. (Photos: Appendix B, Photos 13-14)

Site 8—PVC Wall

The PVC shoreline protection wall and signage are stable. Even with no pile caps, no noticeable deterioration of the timber piles was noticed. Sheet piles in several locations are missing. In several locations along the wall, sheets have become detached and were seen migrating upward. This was the first time that this was seen and could possibly be due to the high water levels. Replacement of these sheet piles may not be possible due to the rock at the base. The wall is still functioning as intended. Signs are all in place and stable. The maintenance event scheduled for the summer of 2014 will add approximately 1,970 linear feet of PVC wall, (as allowed by the remaining budget) in areas as prioritized between Humble Canal and the existing wall. The area around Jackson Bayou will be addressed first. (Photos: Appendix B, Photo 15-16)

c. Maintenance Recommendations

i. Immediate/Emergency

- Construction of a new PVC wall approximately 1,970 linear feet in length between Humble Canal and the existing wall is recommended. The specific locations of construction will be prioritized based on severity and budget. The vicinity around Jackson Bayou should be addressed first.

- Railings located on top of the sheet pile cap of the weirs at Mud Bayou and Bayou Long which hasn't been replaced should be replaced with stainless steel cable and timber piles.

ii. Programmatic/Routine

None at this time.

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**

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

2007 Total	**$5,016.20**
2008 Total	**$2,365**
2009 Total	**$2,149**
2010 Total	**$2,635**
2011 Total	**$2,512**
2012 Total	**$791**
2013 Total	**$3,147.25**
2014 Total	**$1,454.50 (thru April 2014)**

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; however, the final water level data collected from the reference sonde was in November 2004 (Table 2, see TV-04 sondes). There are 7 CRMS-*Wetlands* sites physically located in the project area (Figure 1) and other CRMS sites are available as references (Table 2).

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 project construction, storm disturbance, and switching from project specific to CRMS sondes (Table 2). 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 from the reference sonde (Table 2). 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).

Table 2. Time intervals of interest and sondes used to determine daily range differences for assessing water level variability at East Cote Blanche Bay Hydrologic Restoration project (TV-04) from 1997-2013.

Time Intervals				
Date Range	Name	Sondes	Project	Reference
Jn 1997-Mr 1998	Pre Construction	TV-04	TV04-02/22, -03	TV04-01R
Fb 1999-Ag 2002	Post Construction	TV-04	TV04-02/22, -03	TV04-01R
Sp2002-Nv 2004	Post Hurr Lili	TV-04	TV04-02/22, -03	TV04-01R
Nv 2006-Ag 2007	Pre SBB Structures	CRMS	CRMS0544, 0545	CRMS0489, 0517
Sp 2007-Ag 2008	Post SBB	CRMS	CRMS0544, 0545	CRMS0489, 0517
Sp 2008-Ag 2009	Post Hurr Gustav	CRMS	CRMS0544, 0545	CRMS0489, 0517
Ag 2009-Dc 2010		CRMS	CRMS0544, 0545	CRMS0489, 0517
Jn 2011-Dc 2011	Pre SBB Maintenance	CRMS	CRMS0544, 0545	CRMS0489, 0517
Jn 2012-Dc 2013	Post SBB Maintenance	CRMS	CRMS0544, 0545	CRMS0489, 0517

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 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, and 2013; the final shoreline mapping is scheduled for 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 dates of interest (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 (1998-2013) was analyzed using an ANOVA with a Tukey HSD post test (SAS Institute Inc. 2010).

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 and December 20, 2009. 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). Final aerial photography is scheduled for 2015. Habitat analysis was performed on the 1997 and 2002 aerial photography while a land and water analysis was performed on the 2009 aerial photography; therefore, 1997 and 2002 habitat classifications were lumped into land (emergent, vegetated area) and water (open water and nonvegetated mudflats). In addition a land-to-water analysis was performed from February 2 to October 16, 2002 to detail land changes caused by Hurricane Lili (October 3, 2002).

c. Monitoring Results and Discussion

Water level Variability

The low-level weirs are reducing water level variability within the TV-04 area when free from hurricanes and hydrologic bypassing around the weirs. Monthly averages of daily water level range were plotted for project and reference sondes for project-specific (TV-04) and CRMS sets with delineations for time intervals of interest (Figure 2). In the TV-04 sonde set, reference (TV04-01R) and project (Humble Canal sonde at TV-02/22 and Humble B Canal/Mud Bayou sonde at TV04-03) ranges were closer together during pre-construction than in later 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 less than along ECBB; subsequently, the differences grew after project construction (Figure 3A). In the time interval following project construction, the range difference in water level range tripled at the Humble Canal sonde (TV-02/22) and doubled at the Humble B Canal/Mud Bayou sonde (TV04-03). The range difference at TV04-03 increased by ~25% after Hurricane Lili (Figure 3A). 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 sonde set, range differences between project area sondes over time intervals were statistically significant as an interactive effect (sonde × time interval, $F_{1,4}$=12.1, 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. Water level ranges were typically less at project sondes than the reference following the installation of the SBB structures with the Humble Canal sonde (CRMS0544) having larger range differences than the Humble B Canal/Mud Bayou sonde (CRMS0545) (Figure 3B). While CRMS0545 is influenced by Humble B Canal and Mud Bayou weirs, it is open to WCBB to the north via Bayou Mascot (Figure 1) which allowed for increased ranges relative to the reference for a brief time following Hurricane Gustav (Figure 2B). Following recovery from Hurricane Gustav, CRMS544 water level ranges averaged ~0.6ft below $CRMS_{Refs}$ prior to the SBB Maintenance.

The SBB foreshore rock dike was lifted and SBB/Humble Canal weir replaced by January 2013; thereafter, water level ranges at CRMS0544 increased and were more comparable to those at CRMS0545(Figure 3B). The late increase in water level range at CRMS0544 may be caused by a breach around the Jackson Bayou weir identified during the last OM&M event on May 30, 2012 (Aucoin 2012).

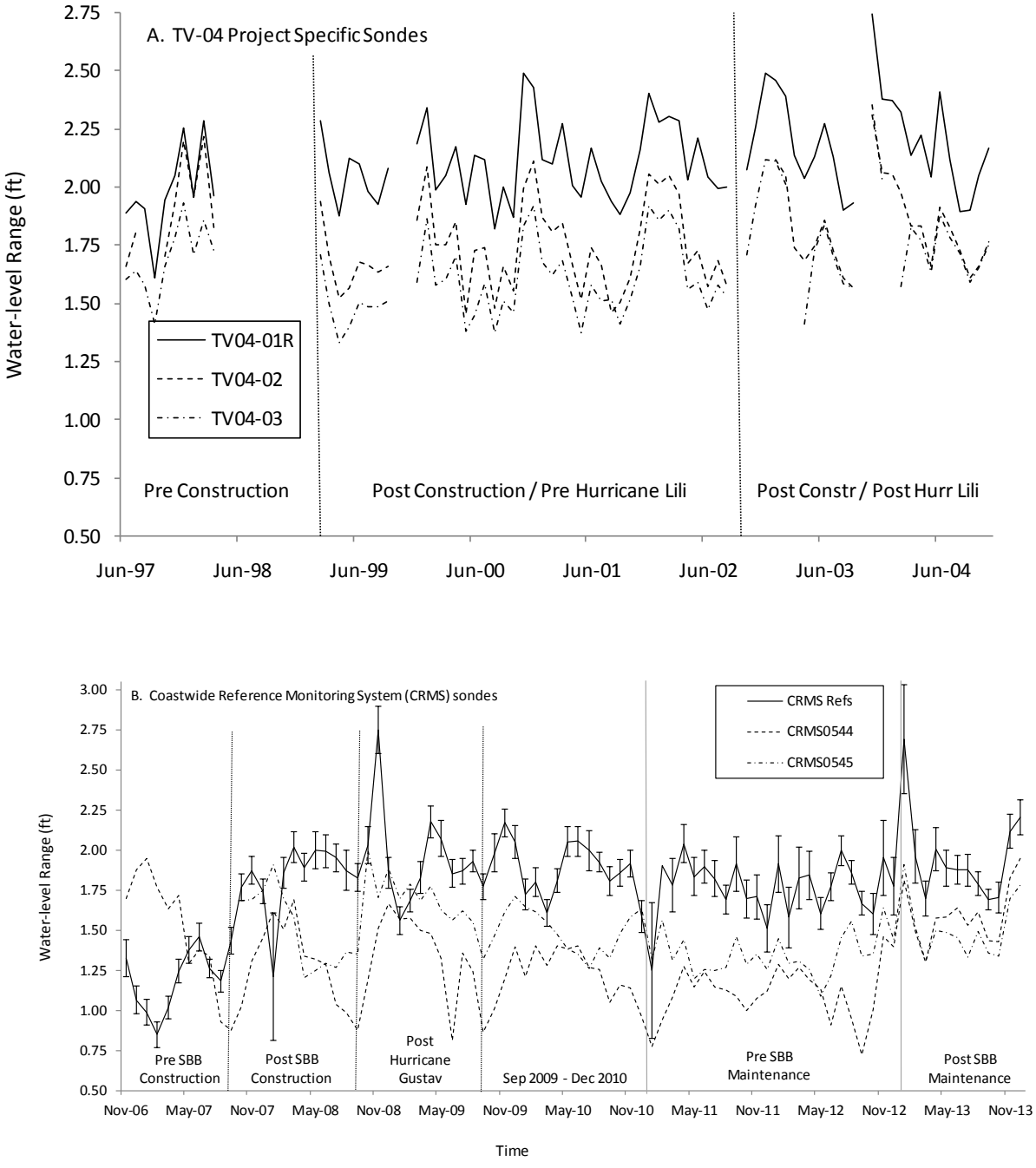


Figure 2. Water level ranges (maximum – minimum per day) collected over time from reference and project sondes (A. TV-04 Project Specific and B. CRMS) at the Cote Blanche Hydrologic Restoration project (TV-04). Values are monthly means of daily ranges. The

reference sonde has the solid line (error bars represent variability among CRMS reference sondes), and the project sondes have dashed lines.

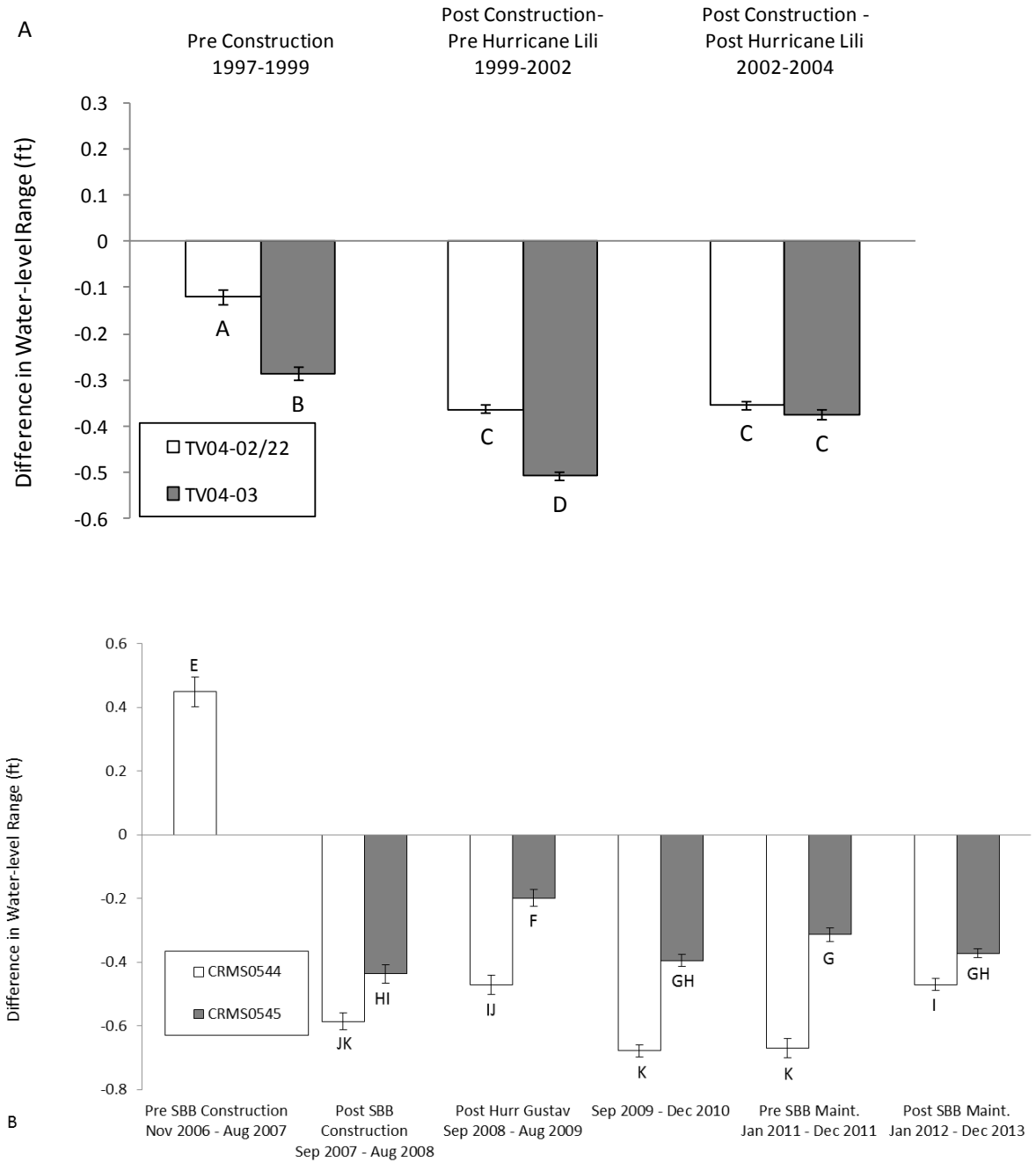


Figure 3. Difference in water level range ($Range_{proj\ i} - Range_{ref}$) collected over time intervals from (A) TV-04 Project Specific and (B) Coastwide Reference Monitoring System (CRMS) sondes at the Cote Blanche Hydrologic Restoration project (TV-04). Values are means and standard errors of daily 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 set

Shoreline Change

Shoreline protection measures have decreased erosion relative to unprotected shorelines although erosion has increased since Hurricanes Lili (2002), Rita (2005), and Gustav and Ike (2008). The relationship among the shoreline protection types changed over the time intervals (shoreline × time, $F_{4,4}$=8.5, p<0.0001, Figure 4), and shoreline change rates differed among shoreline protection types overall (1998-2013, F_4=54.8, p<0.0001, Figure 5). The western unprotected shoreline erosion increased since 2010 by 5.4 m/y (-17.7 ft/y). Erosion behind the foreshore rock dike significantly decreased after installation in 2007 ('01-'07 > '07-'13, t_1=3.3, p=0.0011; Figure 4, 5, and 6) despite rock settling to below the target elevation. However, erosion began to increase since 2010 (-6.2 m/y or -20.3 ft/y), especially in the School Bus Bayou breach areas (Figure 6), which led to lifting of the rock dike in January 2013. The eastern unprotected shoreline had similar erosion rates as the western unprotected shoreline until it decreased inexplicably during the 2007-2010 intervals (Figure 4); erosion then again began to increase after 2010 and continued throughout 2013 (-8.9 m/y or -29.2 ft/y) driven by high erosion rates east of Jackson Bayou (Figure 6). Overall since construction, the shoreline behind the foreshore PVC wall eroded 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. 2007-2010, erosion behind the PVC wall was 3 times less than the western unprotected shoreline but similar to the eastern unprotected shoreline. This trend continued through 2013 except for similarities with the eastern unprotected shoreline (Figure 4). Although the protrusion of the shoreline behind the pre-existing wooden bulkhead is quite visible (Figures 1, 5, 6), it has eroded at the same rate as the west unprotected shoreline since Hurricane Lili as its condition and effectiveness becomes more dilapidated over time (Figures 4, 5, 6).

Land Area Change

The rate of marsh loss has decreased by two-thirds in the TV-04 project area since construction relative to the historical (1957-1990) land loss rate (Table 3; Britsch and Kemp 1990). Most of the land loss that has occurred since project construction in 1999 was the result of Hurricane Lili in 2002 (table 3; Figures 7-10). Although many hurricane shear signatures from Hurricane Lili (southwest to northeast shears; Figures 8 and 9) are persistent and visible in the 2009 map (Figure 10), there was a net gain of land following Hurricane Lili (2003-2009). The net land gain from 2003-2009 exemplifies the areas land building potential in light of anticipated losses during Hurricanes Rita (2005) and Gustav (2008). The decrease in land loss rate of the TV-04 project area does not follow the regional trend for the Teche/Vermilion Basin in which land loss rates are greater since TV-04 construction than historically (table 3); much of the recent loss has been attributed to exacerbation of hurricane impacts (Barras 2009). The reduced tidal exchange via the low-level weirs across the large pipeline canal openings (see Water level Variability above and Figures 2 and 3) is allowing the marsh interior to recuperate following storm surge disturbances. The 2015 imagery should clarify whether or not land gains observed in 2009 are persistent.

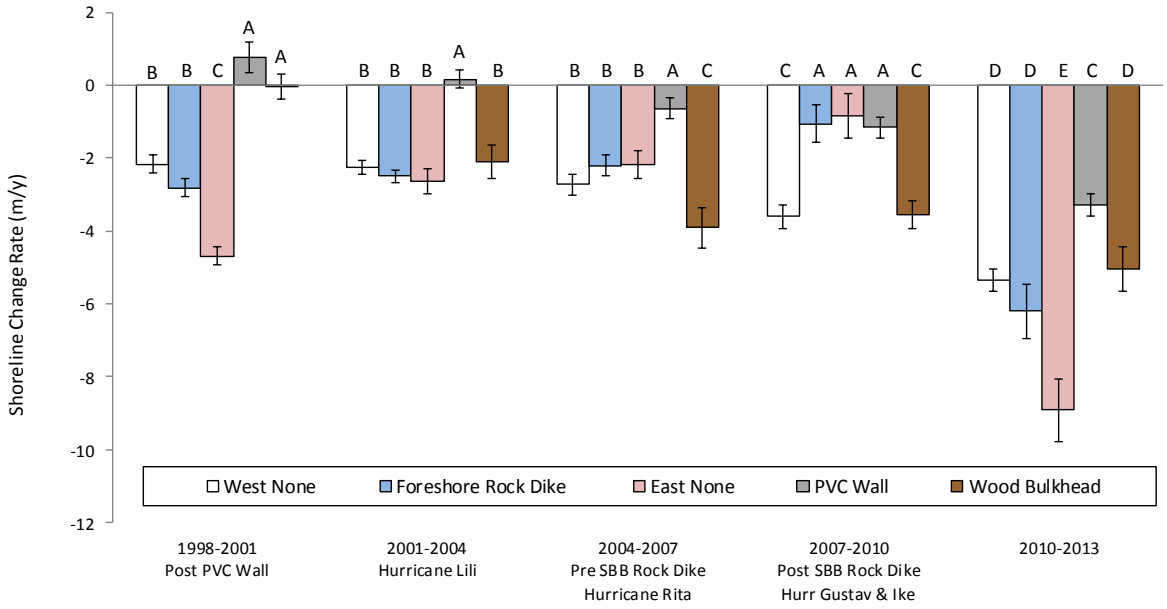


Figure 4. Intervals of shoreline change rates were calculated from shoreline mapping conducted along protected and unprotected shoreline of East Cote Blanche Bay within the TV-04 project area from 1998-2013. Significant events affecting the shoreline in the time intervals were: 1998-2001, initial post construction of the PVC wall east of Humble Canal; 2001-2004, Hurricane Lili; 2004-2007, pre-construction of the foreshore rock dike parallel to School Bus Bayou and Hurricane Rita; 2007-2010, post construction of the SBB rock dike and Hurricanes Gustav and Ike; 2010-2013, SBB rock dike lifted and SBB/Humble Canal weir replaced. Significant differences among shoreline protection types within each time interval are indicated by different letters (Tukey's HSD post test).

Table 3. Land area and land area change rates of TV-04 compiled from high resolution imagery (1:24,000) collected by the USGS-National Wetlands Research Center pre- (1997) and post-construction (2002, 2009). 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; and, Hurricane Gustav occurred in September 2008.

	Land Area	
Date	Acres	Percent
TV-04 Project Area		
January 1997	26,076.3	84.4
December 2002	25,360.1	82.0
December 2009	25,731.0	83.2
Post Construction Change Rate (1997-2009, /y)	-24.3	-0.08
Historical Change Rate (1957-1990, /y)[1]	-75.0	-0.24
Teche/Vermilion (TV) Basin[2]		
Post Construction Change Rate (1999-2009, /y)	N/A	-0.40
Historical Change Rate (1957-1998, /y)	N/A	-0.24

[1] Britsch and Kemp 1990
[2] Adapted from Couvillion et al. 2011

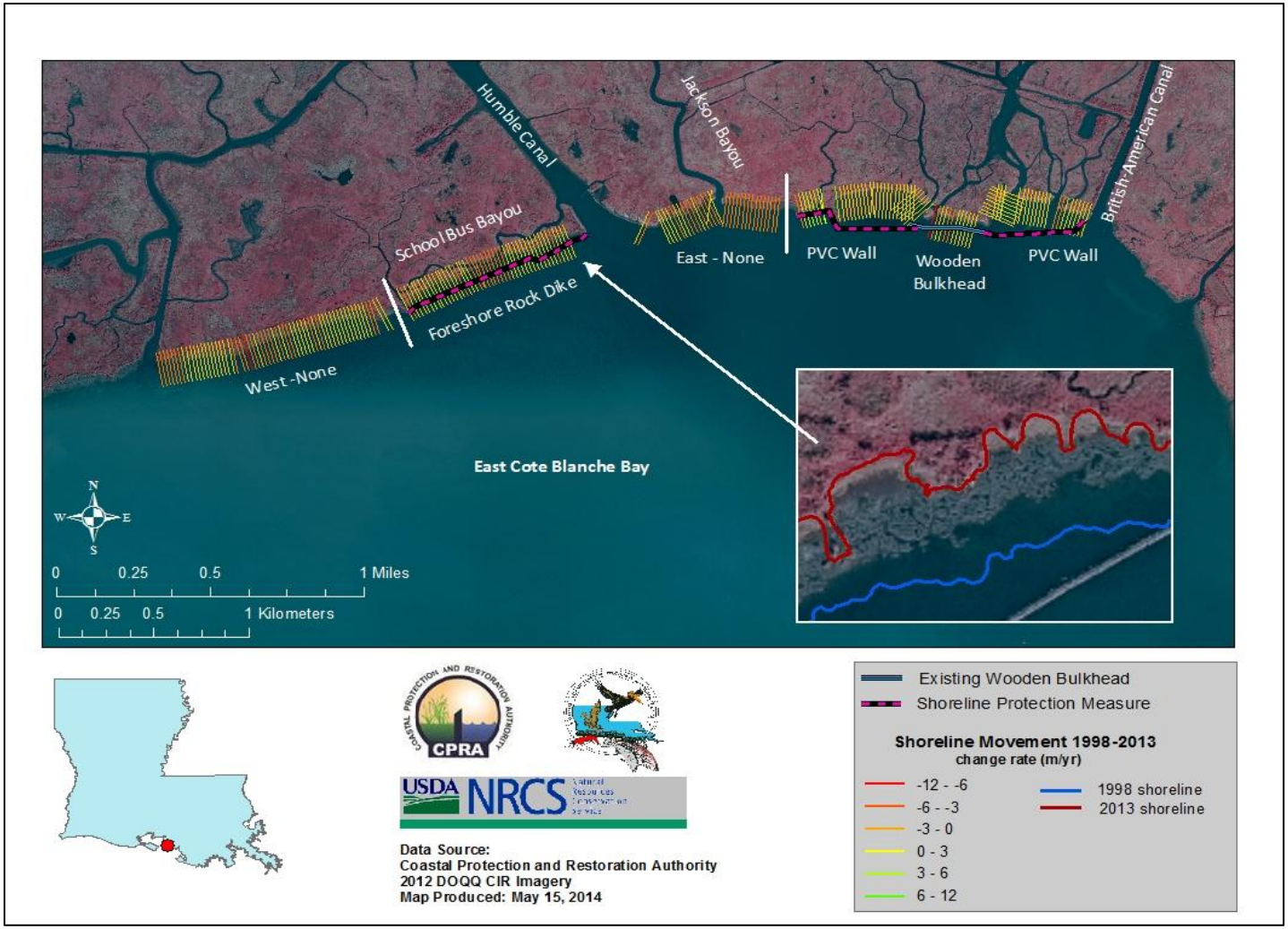


Figure 5. Cote Blanche Hydrologic Restoration (TV-04) shoreline change over the life of the project (1998-2013). The Foreshore Rock Dike was not constructed until 2007, and the Wooden Bulkhead was a pre-existing structure constructed in the late 1950s.

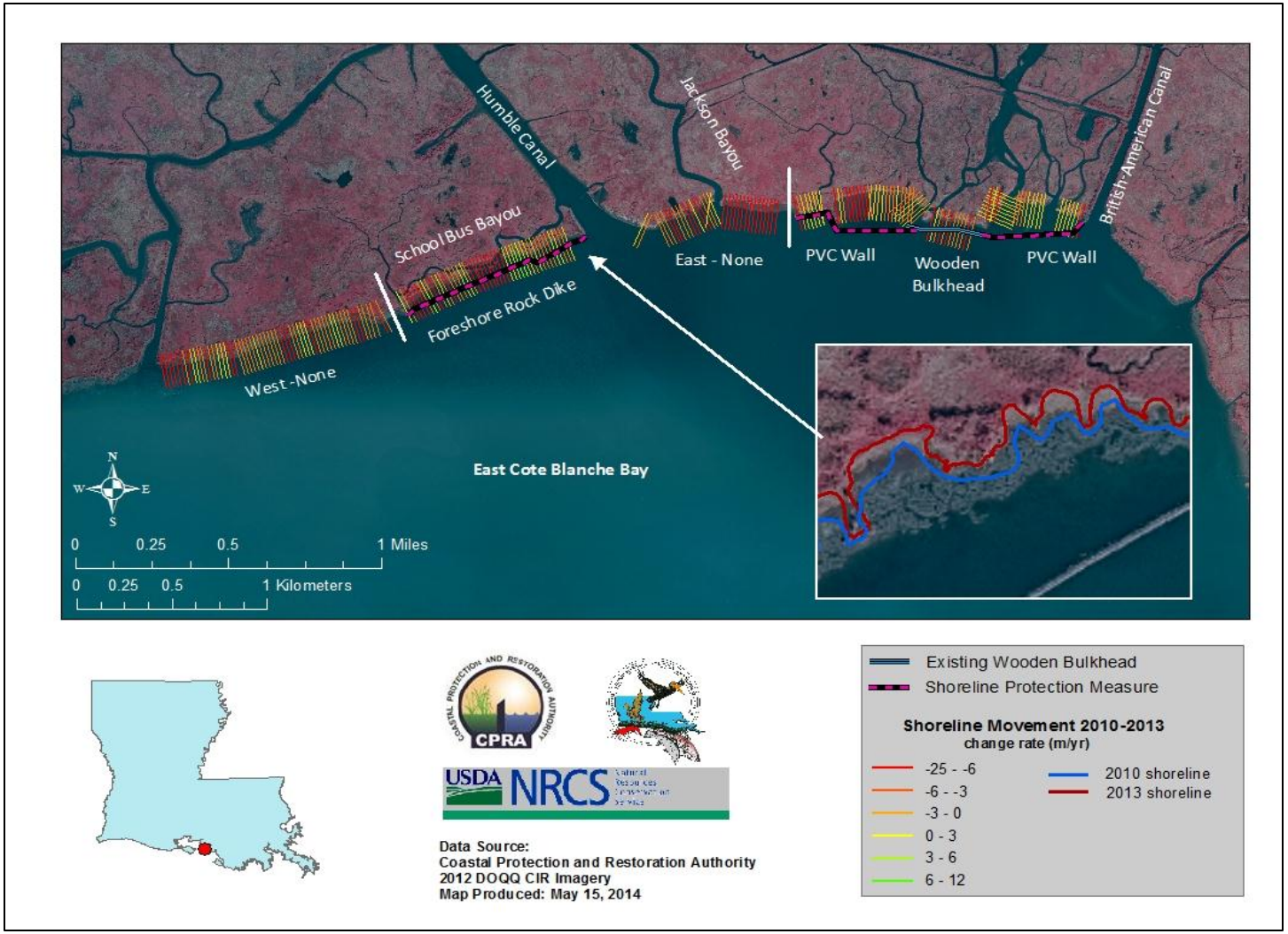


Figure 6. Cote Blanche Hydrologic Restoration (TV-04) shoreline change from 2010 to 2013. The Foreshore Rock Dike was constructed in 2007, and the Wooden Bulkhead was a pre-existing structure constructed in the late 1950s.

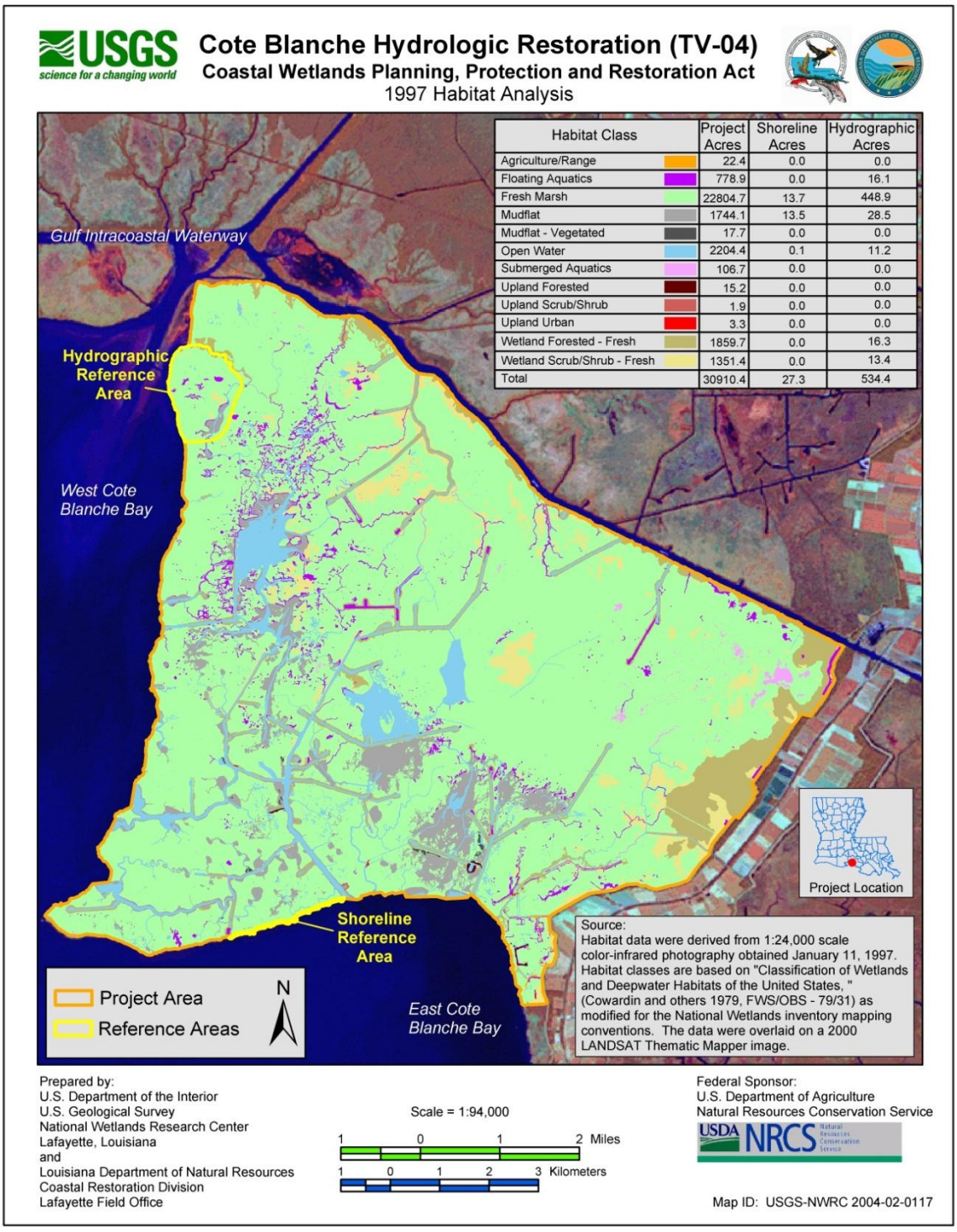


Figure 7. Cote Blanche Hydrologic Restoration (TV-04) 1997 GIS habitat analysis from photography taken January 1997.

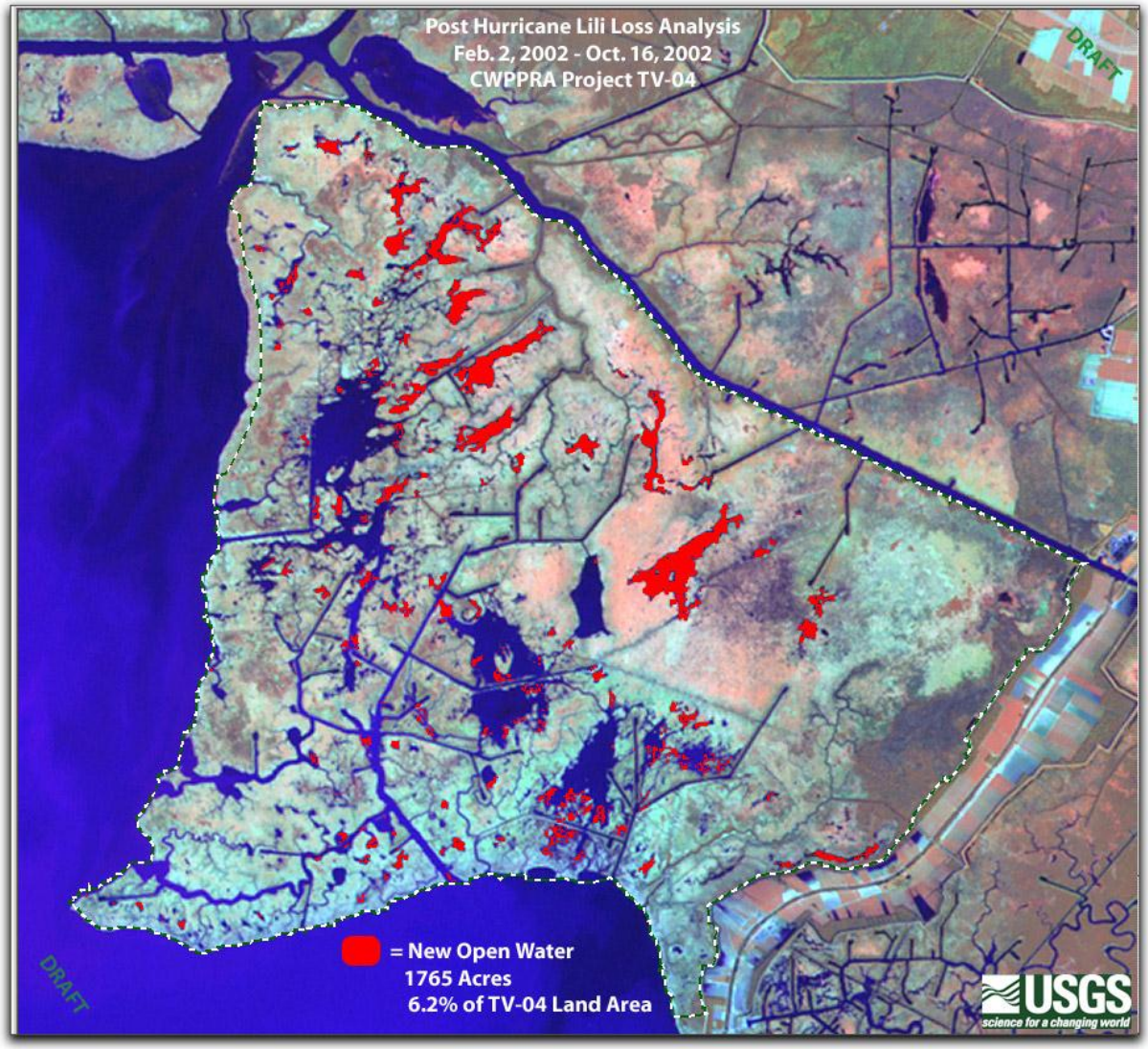


Figure 8. Land to Water change analysis (February 2002 – October 2002) resulting from Hurricane Lili (10/3/02). Satellite imagery and analysis provided by U. S. Geological Survey.

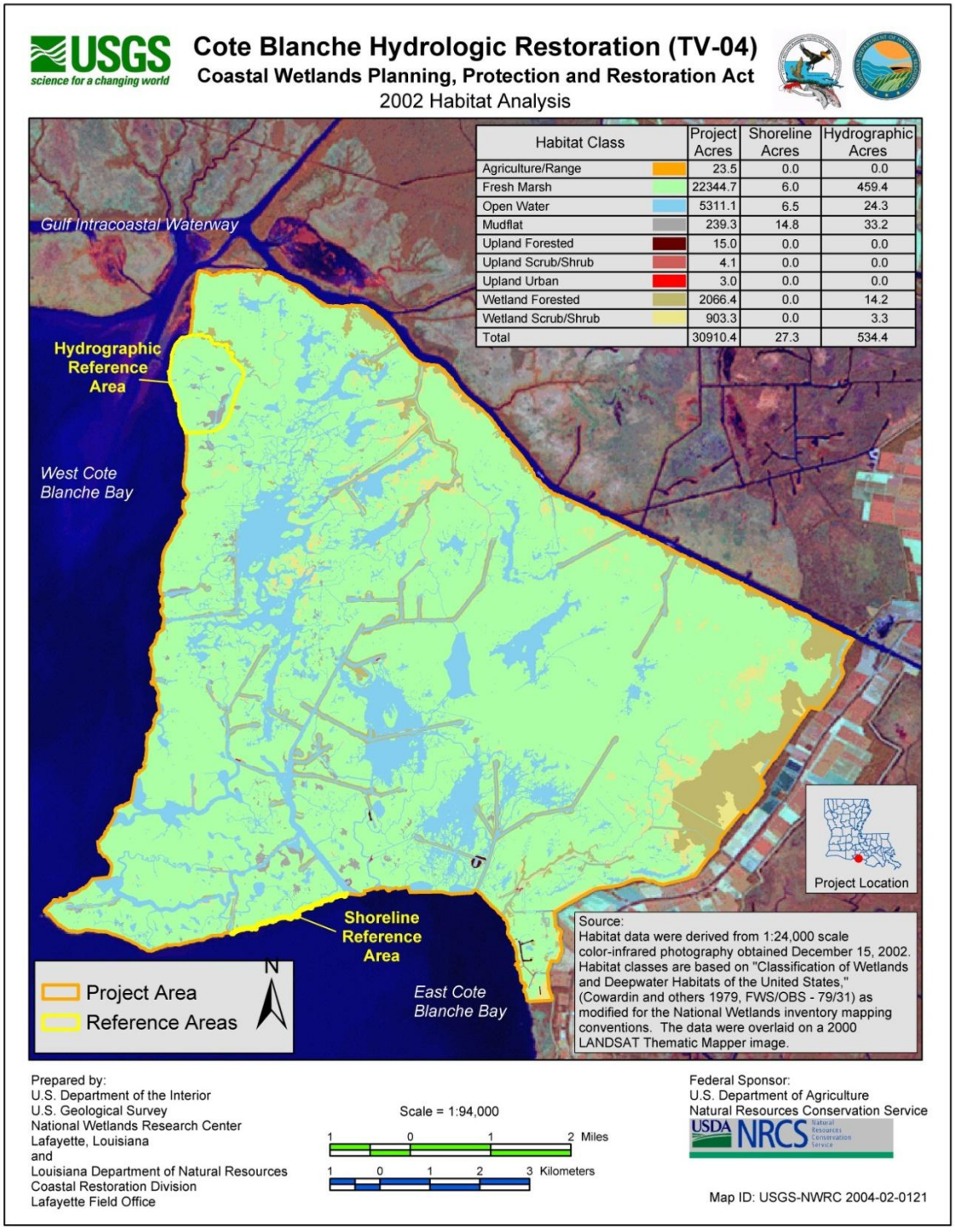


Figure 9. Cote Blanche Hydrologic Restoration (TV-04) 2002 GIS habitat analysis from photography taken December 2002 (after Hurricane Lili).

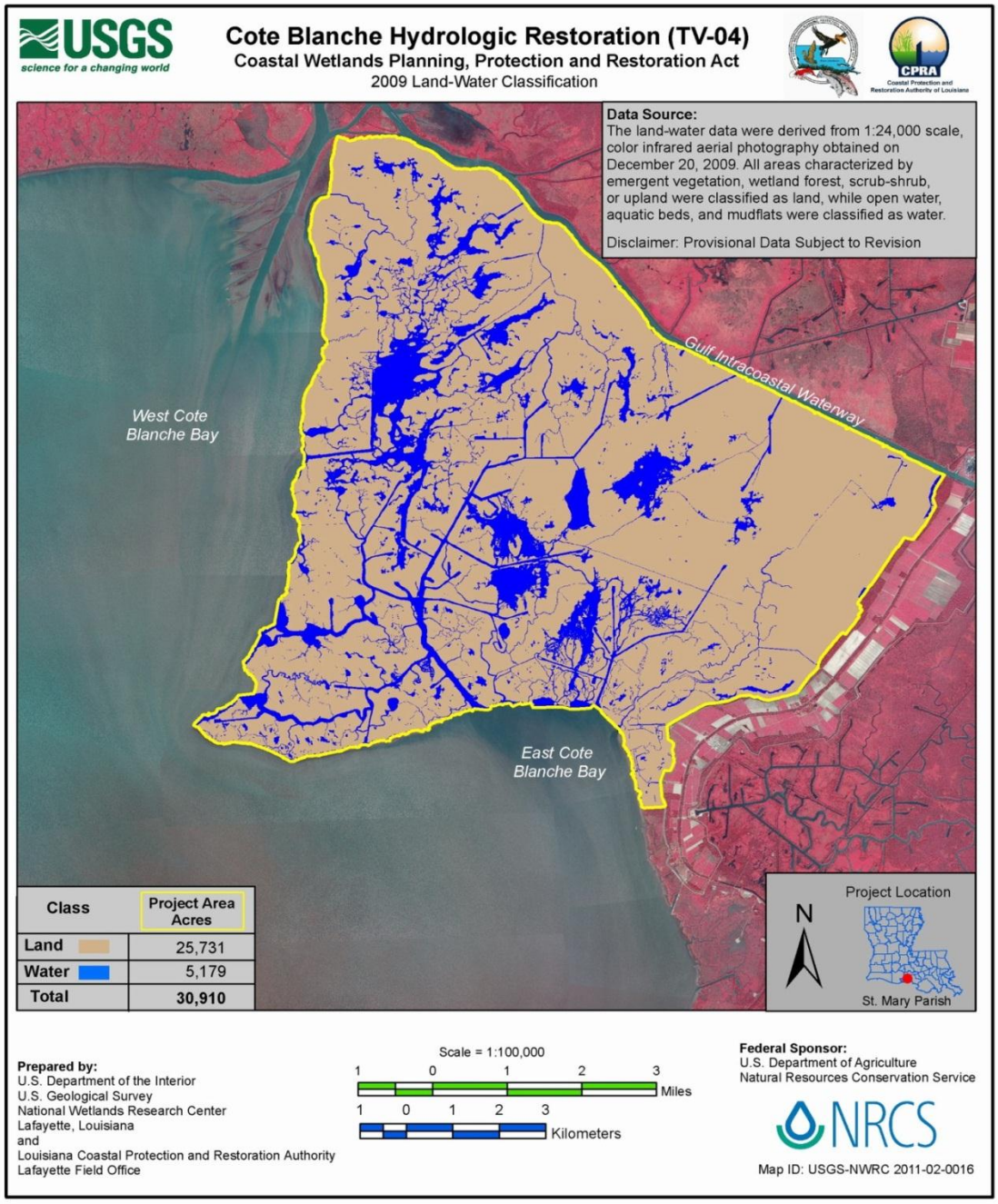


Figure 10. Cote Blanche Hydrologic Restoration (TV-04) 2009 land and water analysis from photography taken December 2009.

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, thus far (1999-2013). The reduced tidal exchange via the low-level weirs across the large pipeline canal openings is decreasing daily hydraulic energy which reduces daily export of vulnerable organic soils and allows the marsh interior to recuperate following storm-surge disturbances.

The low-level weirs are decreasing water level variability within the TV-04 area when surrounding conditions are within the design specification such as being free from hurricanes and water not bypassing around the weirs. Given the design of the submerged weirs, most of the decreased water level variability is associated with the low tides.

The rate of marsh loss has decreased by two-thirds in the TV-04 project area since construction relative to the historical (1957-1990) land loss rate. Most of the land loss that has occurred since project construction in 1999 was the direct result of Hurricane Lili in 2002, and a net gain of land followed Hurricane Lili (2002-2009).

Shoreline protection measures have significantly reduced erosion relative to unprotected shorelines. Prior to Hurricane Lili, the shoreline was prograding behind the PVC wall; although at a significantly lower rate than unprotected shoreline reaches, the shoreline behind the PVC wall has begun to erode since hurricanes in 2002 (Lili), 2005 (Rita), and 2008 (Gustav and Ike). Shoreline erosion behind the foreshore rock dike, which was constructed in 2007 to prevent breaching of School Bus Bayou, decreased after installation despite settling to below the target elevation. Since 2010 however, there has been a significant increase in erosion at all shoreline reaches. Rates have more than doubled at the foreshore rock dike (most likely due to widening of breaches in School Bus Bayou), eastern unprotected shoreline and PVC wall; while shorelines behind the wooden bulkhead and west unprotected area have increased by approximately -0.46 m/y (-1.5ft/yr). Although shoreline erosion increased behind the PVC wall, overall it has eroded the least of all the shoreline reaches. The significant increase of erosion rates for the eastern unprotected stretch is a result of the structure on the eastern side of Jackson Bayou having been circumvented.

b. Recommendations

Most of the components of the Cote Blanche Hydrologic Restoration Project are in basically good condition and continuing to function as intended. The unprotected shoreline on the southern end of the project continues to suffer from severe erosion. The additional PVC wall will attempt to address the most critical of these areas within the project area.

Conduct a 2015 land-to-water change analysis to identify land loss and gain relative to project structures prior to the project end of life.

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.

Although the rock dike at School Bus Bayou settled to below design specifications, it still reduced erosion relative to unprotected shoreline reaches.

VI. Literature Cited

Aucoin, S. 2012. *2011/2012 Annual Inspection Report for Cote Blanche Hydrologic Restoration (TV-04),* Coastal Protection and Restoration Authority of Louisiana, Lafayette, Louisiana. 28 pp and Appendices.

Barras, J.A. 2009. Land area change and overview of major hurricane impacts in coastal Louisiana, 2004-2008. U.S. Geological Survey Scientific Investigations Map 3080, scale 1:250,000. 6 p. pamphlet.

Britsch, L.D. and Kemp, E.B. 1990. "Land Loss Rates: Mississippi River Deltaic Plain," Technical Report GL–90–2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Chabreck, R. H., and G. Linscombe 1978. Vegetation type map of the Louisiana coastal marshes. Louisiana Department of Wildlife and Fisheries, New Orleans. Scale: 1:62,500.

---------- 1988. Vegetation type map of the Louisiana coastal marshes. Louisiana Department of Wildlife and Fisheries, New Orleans. Scale: 1:62,500.

---------- 1997. Vegetative type map of the Louisiana coastal marshes. Louisiana Department of Wildlife and Fisheries, Baton Rouge.

Chabreck, R. H., T. Joanen, and A. W. Palmisano 1968. Vegetation type map of the Louisiana coastal marshes. Louisiana Department of Wildlife and Fisheries, New Orleans. Scale: 1:62,500.

Couvillion, B.R., J.A. Barras, G.D. Steyer, W. Sleavin, M. Fischer, H. Beck, N. Trahan, B. Griffin, and D. Heckman. 2011. Land area change in coastal Louisiana from 1932 to 2010. U.S. Geological Survey Scientific Investigations Map 3164, scale 1:265,000. 12 p. pamphlet.

Delaune, R.D., C.J. Smith, W.H. Patrick Jr, and H.H. Roberts 1987. Rejuvenated Marsh and Bay-bottom Accretion on the Rapidly Subsiding Coastal Plain of U.S. Gulf Coast: a Second-order Effect of the Emerging Atchafalaya Delta. Estuarine, Coastal and Shelf Science 25:381-389.

Louisiana Department of Natural Resources (LDNR) 1999. Project Overview Cote Blanche Hydrologic Restoration Project TV-04 St. Mary Parish, LA. Baton Rouge: Coastal Restoration Division. www.gov/Programs/CWPPRA/Projects/teche/CoteBlanche/.

O'Neil, T. 1949. Map of the southern part of Louisiana showing vegetation types of the Louisiana marshes. Louisiana Department of Wildlife and Fisheries New Orleans.

SAS Institute Inc. 2010. JMP 9.0.1. SAS Campus Drive, Cary, NC, USA 27513.

Steyer, G. D., R. C. Raynie, D. L. Steller, D. Fuller, and E Swenson. 1995. Quality management plan for Coastal Wetlands Planning, Protection, and Restoration Act monitoring plan. Open-file series 95-01. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division.

Thieler, E.R., E.A. Himmelstoss, J.L.Zichichi, and A. Ergul. 2009. Digital Shoreline Analysis System (DSAS) version 4.0—An ArcGIS extension for calculating shoreline change. U.S. Geological Survey Open-File Report 2008-1278. Available online at http://pubs.usgs.gov/of/2008/1278/.

Appendix A
Photographs

Photo 1--Mud Bayou structure

Photo 2--Humble F Canal structure

Photo 3—damaged rail on Bayou Long structure

Photo 4--Bayou Carlin Structure

Photo 5--Humble Canal structure; east side

Photo 6—Humble Canal structure; west side

Photo 7--rock on east side of Humble Canal

Photo 8—typical section of 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

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 PVC wall

Photo 16—rising sheet pile on PVC wall

Appendix B
Three Year Budget Projection

COTE BLANCHE/ TV-04 / PPL 3

Three-Year Operations & Maintenance Budgets 07/01/2014 - 06/30/2017

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

	2014/2015 (-15)	2015/2016 (-16)	2016/2017 (-17)
Maintenance Inspection	$ 6,651.00	$ 6,851.00	$ 7,057.00
Nav. Aid Inspections	$ 5,000.00	$ 5,000.00	$ 5,000.00
State Administration	$ 10,000.00		
Federal Administration	$ 5,000.00		
Maintenance/Rehabilitation			

14/15 Description: E&D and Construction Oversight for PVC Wall.

E&D	$ 55,000.00
Construction	$ 1,318,349.00
Construction Oversight	$ 100,000.00
Sub Total - Maint. And Rehab.	$ 1,473,349.00

15/16 Description:

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

16/17 Description:

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

	2014/2015 (-15)	2015/2016 (-16)	2016/2017 (-17)
Total O&M Budgets	**$ 1,500,000.00**	**$ 11,851.00**	**$ 12,057.00**

O &M Budget (3 yr Total)	**$ 1,523,908.00**
Unexpended O & M Budget	**$ 1,529,544.00**
Remaining O & M Budget (Projected)	**$ 5,636.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

COTE BLANCHE HR / PROJECT NO. TV-04 / PPL NO. 3 / 2014/2015

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,651.00	**$6,651.00**
Nav Aid Inspection	LUMP	1	$5,000.00	**$5,000.00**
Engineering and Design	LUMP	1	$55,000.00	**$55,000.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	1	$100,000.00	**$100,000.00**

ADMINISTRATION

CPRA Admin.	LUMP	1	$10,000.00	$10,000.00
FEDERAL SPONSOR Admin.	LUMP	1	$5,000.00	$5,000.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$15,000.00**

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: Construct 1,500 LF of PVC sheet pile wall from Humble Canal to existing PVC wall.

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	$10.00	$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)	LF	1,500	$225.00	$337,500.00
Timber Piles (each or lump sum)	EACH	300	$2,400.00	$720,000.00
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	1	$75,000.00	$75,000.00
Contingency	LUMP	1	$95,849.00	$95,849.00
General Structure Maintenance	LUMP	0	$0.00	$0.00
Vegetative Plantings	LUMP	0	$0.00	$0.00
Whalers	LF	3,000	$30.00	$90,000.00
OTHER			$0.00	$0.00
			TOTAL CONSTRUCTION COSTS:	**$1,318,349.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$1,500,000.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

COTE BLANCHE HR / PROJECT NO. TV-04 / PPL NO. 3 / 2015/2016

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,851.00	**$6,851.00**
Nav Aid Inspection	LUMP	1	$5,000.00	**$5,000.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
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	$10.00	$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)		LF	0	$0.00	$0.00
Timber Piles (each or lump sum)		EACH	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	1	$0.00	$0.00
Contingency		LUMP	1	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
Vegetative Plantings		LUMP	0	$0.00	$0.00
Whalers		LF	0	$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$11,851.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

COTE BLANCHE HR / PROJECT NO. TV-04 / PPL NO. 3 / 2014/2015

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$7,057.00	**$7,057.00**
Nav Aid Inspection	LUMP	1	$5,000.00	**$5,000.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
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	$10.00	$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)		LF	0	$0.00	$0.00
Timber Piles (each or lump sum)		EACH	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		LUMP	0	$0.00	$0.00
Vegetative Plantings		LUMP	0	$0.00	$0.00
Whalers		LF	0	$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$12,057.00**

Appendix C
Field Inspection Forms

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-04 Cote Blanche

Date of Inspection: April 23, 2014 Time:

Structure No. 7 British American Canal

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

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

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			13, 14	Some initial post construction rusting. No action needed.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles	see signage				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	fair				
Rip Rap (fill)	good				Rock between PVC wall and shoreline has settled but is still functional.
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: April 23, 2014 Time:

Structure No. 2 Humble F Canal

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

Structure Description: Fixed crest weir, rock paving on bank

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			2	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	N/A				
Signage /Supports	good				
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: April 23, 2014 Time:

Structure No. 5 Humble Canal

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

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

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good				Some initial post construction rusting. No immediate action needed.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	fair				
Timber Piles	N/A				
Timber Wales	N/A				
Galv. Pile Caps	good				
USCG Lights	good			5	
Signage /Supports	good			6	
Rip Rap (fill)	good			7	
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: April 23, 2014 Time:

Structure No. 8 PVC wall

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

Structure Description: approximately 3800 linear feet of PVC wall

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
PVC sheet piling / Caps	fair			15,16	PVC wall appears to be in post construction condition and holding up well. Some piles have been broken or displaced. No gaps are wider than 3-4 feet however and the wall is still functioning
Steel Grating					
Stop Logs					
Hardware	good				
Timber Piles	good				Nearly all pile caps missing. Attempts to replace these have been unsuccessful. Condition of the piles will be monitored.
Timber Wales	good				
Galv. Pile Caps					
Cables					
Signage /Supports	good				All signs are in place. Some retaping with reflective tape is required.
Rip Rap (fill)	good				Rock placed along the inside and outside of the PVC wall is still in place and functional. No action necessary.
Earthen Embankment					

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: April 23, 2014 Time:

Structure No. 3 Bayou Long

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

Structure Description: Fixed crest weir

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good				
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			3	
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: April 23, 2014 Time:

Structure No. 1 Mud Bayou

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

Structure Description: Fixed crest weir, rock paving on bank

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy 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	N/A				
Signage /Supports	good				
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: April 23, 2014 Time:

Structure No. 6 Jackson Bayou

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

Structure Description: Fixed crest weir

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			11,12	Some slight rusting of pile caps.
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles	poor				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	good				
Rip Rap (fill)	good				Shoreline where rock was placed has stabilized the shoreline however the shore on the eastern end of the structure has eroded to the point that water will soon circumvent the structure. This area will need to be addressed should additional funding be provided.
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: April 23, 2014 Time:

Structure No. 4 Bayou Carlin

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

Structure Description: Fixed crest weir

Water Level Inside: Outside:

Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good			4	Structure in pristine post-construction condition. Some slight rusting of pile caps. No immediate action necessary.
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				
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: April 23, 2014 Time:

Structure No. School Bus Bayou SP

Inspector(s):Stan Aucoin, Dion Broussard, Maggie Hawkins (CPRA) Cindy Steyer (NRCS), John Foret (NMFS)

Structure Description: Foreshore Rock Dike & Weirs

Water Level +3.0

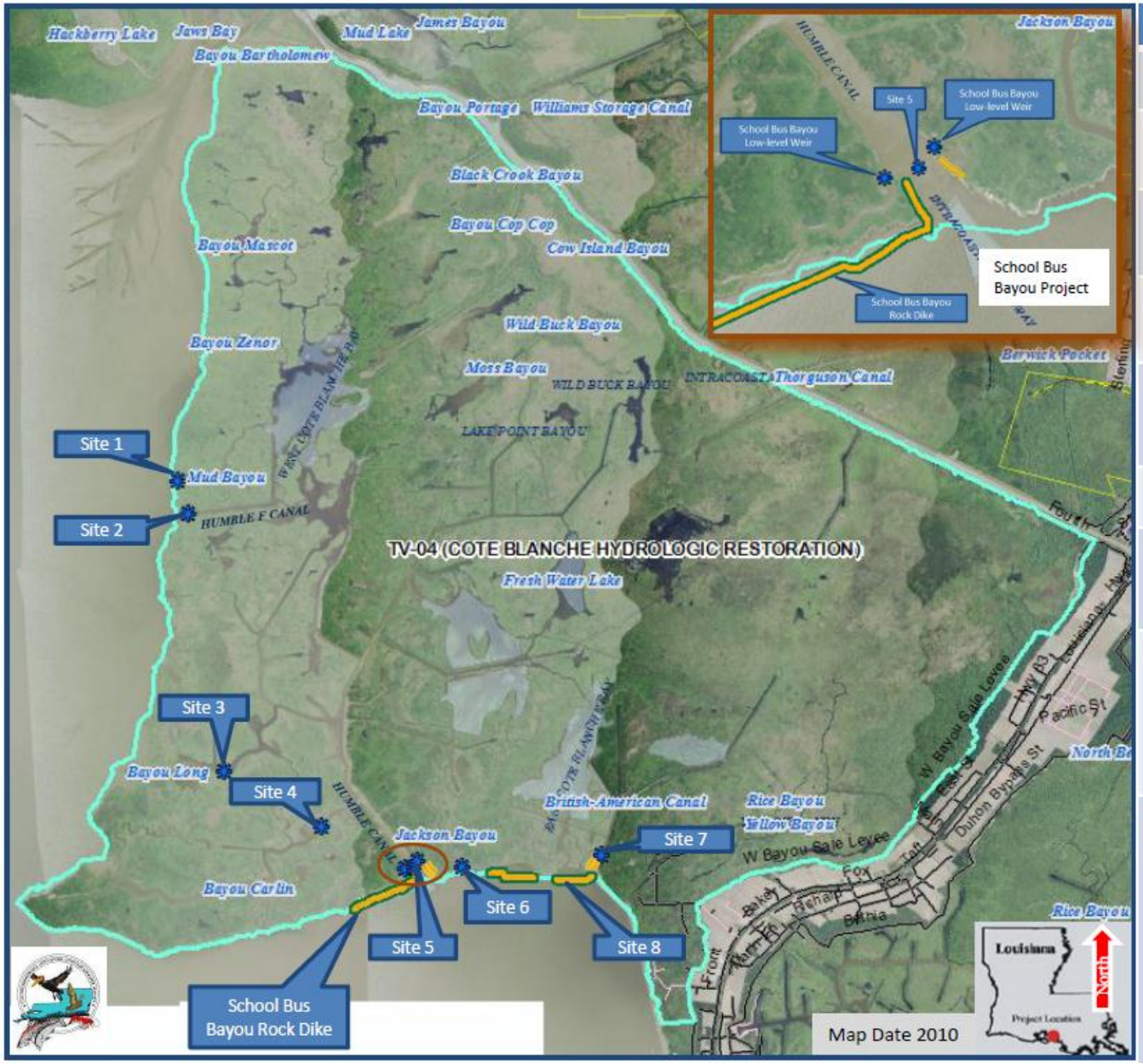
Type of Inspection: Annual

Weather Conditions: Cloudy and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	N/A				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	N/A				
Timber Piles	N/A				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	Good			8, 9, 10	Signage is intact
Rip Rap (fill)					No significant additiona settlement of rock dike.
School Bus Bayou	Good			8	
Low Level Weirs	Good			9,10	
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?

Appendix D
Constructed Project Features Map



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