State of Louisiana

Coastal Protection and Restoration Authority (CPRA)

2018 Operations, Maintenance, and Monitoring Report

for

East Marsh Island Marsh Creation

State Project Number TV-21
Priority Project List 14

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Iberia Parish

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For
East Marsh Island Marsh Creation (TV-21)

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Preface

This report includes monitoring data collected through December 2017, and the annual maintenance inspections from May 2018.

The 2018 report is the 2nd report in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2013 Operation, Maintenance and Monitoring Report on the CPRA web site at http://coastal.Louisiana.gov/. This report and others are available for download at the following website: http://cims.coastal.la.gov.

I. Introduction

The East Marsh Island Marsh Creation Project (TV-21) was proposed on the 14th project priority list of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) and is co-sponsored by the U.S. Environmental Protection Agency (EPA), the Natural Resources Conservation Service (NRCS), and the Coastal Protection and Restoration Authority (CPRA). It is located in southeast Iberia Parish on the Marsh Island Wildlife Refuge. The project is bordered to the north by West Cote Blanche Bay, to the south and east by East Cote Blanche Bay, and to the west by the Marsh Island Hydrologic Restoration project (TV-14) (Figure 1). The total area of the project is approximately 1,159 acres (469 ha) and is comprised of 362 levee-contained acres (146 ha) of marsh and 797 acres (323 ha) of non-contained marsh.

Marsh Island is economically and biologically important as a haven for wintering waterfowl (CPRA 2008), as well as a sanctuary for juvenile and adult saltwater fish and shrimp species, and blue crabs (*Callinectes sapidus*). The island also functions as a barrier island, buffering the effects of hurricane storm surges on coastal communities. The project area is a brackish, *Spartina patens* (marshhay cordgrass) dominated marsh which has historically been relatively stable, exhibiting a low land loss rate of -0.29% per year for the period 1974-2000 (Natural Resources Conservation Service [NRCS] 2004). Marsh loss was again calculated for the period 1988-2007 by the U.S. Environmental Protection Agency (EPA) in 2008 to include loss due primarily to Hurricane Lili in 2002. This marsh loss rate was found to be -1.31% per year, much higher than the previous determination. With Hurricane Gustav in 2008 and future hurricanes, this land loss rate will likely increase. Nyman et al. (1994) confirmed the role of hurricanes in marsh loss in this area by determining disturbance as the driving force behind marsh loss in the interior of Marsh Island. This form of lateral erosion is fundamentally different from the more rapid form of marsh loss associated with vegetation stress due to saltwater intrusion and low marsh elevation. Lateral marsh erosion progresses through the undercutting of the marsh substrate below the root zone and can be prevented by filling in the previously eroded marsh areas with new sediments.

The primary purpose of the marsh creation component of the TV-21 project is to restore areas that were previously lost due to this lateral marsh erosion. The project was designed to target the areas of the island exhibiting the most land loss due to Hurricane Lili (EPA 2008). The marsh nourishment component of the TV-21 project was designed to deposit new sediments

into uncontained marsh areas in the project and provide an influx of nutrients, as well as the benefits of increased elevation.

The project consists of the addition of 3,836,209 yd^3 (2,933,000 m^3) of sediment hydraulically dredged from a borrow location in East Cote Blanche Bay directly east of the project area, creating 362 acres (146 ha) of emergent marsh within 14,000 linear ft (4,267 m) of containment levees. Construction of the containment areas began on March 27, 2010 and was completed on September 20, 2010. The interior containment dike was degraded and gaps were created in some of the perimeter levees in December 2010 to facilitate the natural sheet flow of water and nutrients. Construction of an additional 797 acres (323 ha) of created/nourished marsh, outside of the contained areas, was completed on November 4, 2010. Dr. Herry Utomo established an aerial seeding trial using different application rates of Poly C15 *Spartina alterniflora* seed on April 25, 2011. A 10 acre plot in containment area 2 was reserved for the trial and consisted of three planting strips with three different seeding rates along each strip. In July 2011, 3,257 plants (*Spartina alterniflora, Spartina patens, Paspalum vaginatum, Distichlis spicata, Spartina cynosuroides*) were installed in containment area 1. However, due to contracting issues, the plantings were discontinued.

The State of Louisiana's Master Plan (CPRA 2012) identified marsh restoration using dredged material at Marsh Island as a method for restoring and maintaining critical landscape features and providing hurricane protection to coastal Louisiana west of the Atchafalaya River. The TV-21 project will contribute to that goal.

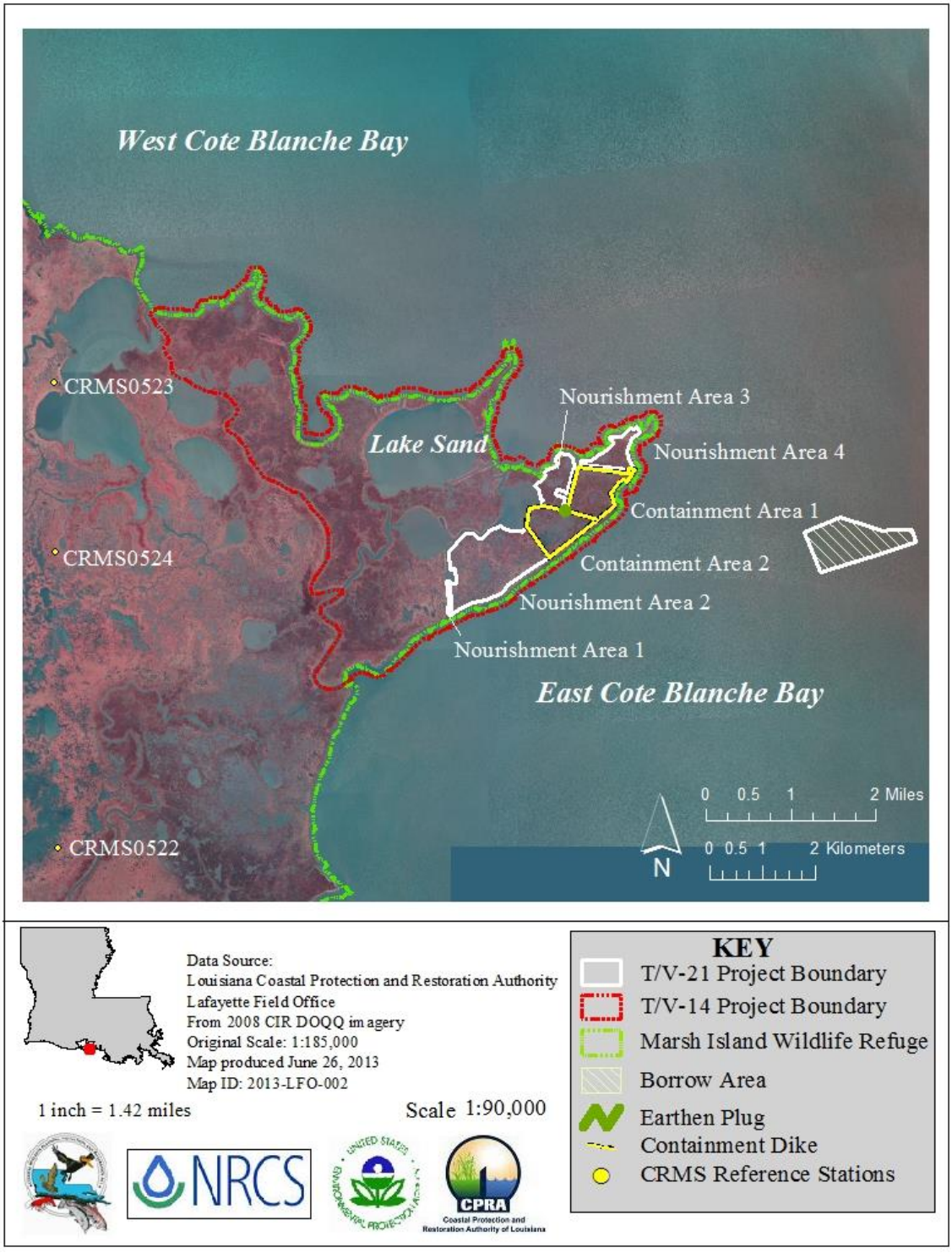

Figure 1. East Marsh Island Marsh Creation (TV-21) project boundary and project features**.**

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the East Marsh Island Marsh Creation Project (TV-21) 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 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. A summary of past operation and maintenance projects completed since completion of the East Marsh Island Marsh Creation Project are outlined in Section IV.

An inspection of the East Marsh Island Marsh Creation Project (TV-21) was held on May 16, 2017 under sunny skies, mild temperatures, and choppy seas. In attendance were Darrell Pontiff, Dion Broussard, Mark Mouledous, and Jody White from CPRA, Tyson Crouch and Steven Berger from LDWF, Sharon Osowski from EPA, Dale Garber from NRCS and Scott Wandell from USACE. Parties met at the Quintana Boat launch at Cypremort Point at 10:00am and traveled to the Northeast corner of Marsh Island. WLF provided boat transportation.

The field inspection included a visual inspection of the project site. Staff gauge readings were not available to determine approximate elevations of water level. 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).

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b. Inspection Results

<u>Site 1—Marsh Creation Cells (Containment Areas No. 1&2)</u>

The two marsh creation containment areas are in good condition since constructed in 2010. Vegetation is thriving since curbing the nutria population.

The latest Topographic Survey completed in 2017 by T. Baker Smith provided a good comparison of elevation data from 2011 to 2017 within the marsh creation areas. The containment areas were surveyed on transect line spaced 500ft apart with shots taken every 50ft. Survey data showed that the average marsh elevation within the containment areas was approximately +1.33 ft NAVD88. This is a decrease in marsh elevation of an average of 1.73 ft, from construction completion, which is consistent with the original settlement curve projections.

The remnant containment dike is at an average elevation of +3.37ft NAVD88 with 15 gaps to allow tidal exchange. Vegetation has expanded on the dikes which negated the need to plant.

The concrete articulated mats placed in March 2015 on the Northeast corner of the island in Marsh Creation Containment Area No. 1 at the East-West Pipeline Canal has settled significantly at the original breach location. However, it continues to break the wave action approaching the shoreline. In addition, from topographic survey information the borrow channel on the interior of the containment dike which was excavated to repair the breach has infilled to -2.5ft NAVD88.

(Photos: Appendix B, Photo 1- 4&6)

Site 2—Nourished Areas (Additional Fill Areas No. 1-4)

Only Nourished Areas No. 3 & 4 were visible during the site visit. Located on the Northeast tip of the island, shoreline erosion continues to degrade the point. The vegetation is thriving since the nutria population is under control.

The 2017 Topographic Survey, previously mentioned, incorporated elevation data at specific points within each Nourished Area, rather than along transect lines at incremental spacing. The locations observed were repeated sites from the prior survey tasks in order to make comparisons over time. Nourished Area No. 1 being relatively small had three (3) point surveys taken. In Nourished Area No. 2, nineteen (19) points were surveyed. Nourished Area No. 3 had three (3) point locations, and Nourished Area No. 4 had four (4) locations.

Comparing the 2011 and the 2017 Topographic Surveys, Nourished Area No.1 has seen a minor decrease in elevation ranging from 0 in. to 6 in. Note that Nourished Area No. 1 was a prior oilfield canal infilled during construction. After the initial fill material consolidated, this area drained poorly and was holding water. During the post construction maintenance event (2014), gaps were constructed to allow proper drainage.

Nourished Area No. 2 is showing a positive elevation trend in the nineteen locations ranging from a 1 in. to a 7 in. increase and an average of 3.8 in. increase between observations taken in 2011 and 2017.

Nourished Areas No. 3 & 4 experienced relatively minor net change. Despite one location with a 10 in. decrease, each other location observed in Nourished Area No. 3 had a 1.2 in. elevation increase. Nourished Area No. 4 had an elevation change ranging from -2.4 in. to +2.4in.

(Photos: Appendix B, Photo 2)

Site 3—Earthen Plug

The earthen plug at the end of the North-South Pipeline Canal was intact. (Photos: Appendix B, Photo No. 4)

Site 4—Vegetation plantings

The vegetation in the marsh creation cells and containment dikes has propagated well despite the nutria damage seen in prior years. The Nutria Program implemented by LAWLF has effectively controlled the nutria population giving the vegetation time to reestablish itself. At this time, no additional plantings are planned.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs
None

ii. Programmatic/ Routine Repairs
None

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance tasks performed since December 2010.

2011-2014 Survey and Maintenance Event –

T. Baker Smith Year 1 Survey (2011-2012):
Elevation Survey of the marsh creation areas, borrow area, and CRMS-like stations

Professional Construction Services, Inc.
Post Construction Maintenance Event (2014-2015):

-Excavation of four interior plugs left from original construction in Marsh Nourishment Areas No.1 & 2
-Removal of a timber mat plug in the Marsh Creation Cell No. 2 containment dike near Hawkins Lake with creation of a 100 foot gap
-Degrading of an existing Gap "N" between Marsh Creation Cell No. 2 and Nourishment Area No. 3

-Repair and installation of articulated concrete mat armoring of 890ft of containment dike on the East End of the East-West Pipelline Canal along the Gulfward shoreline.

In conjunction with this maintenance event, the existing rock plug at the West end of the East-West Canal was removed and replaced with improvements to repair erosion occurring around the plug as part of TV-14 maintenance. In addition, LAWLF installed a PVC sheetpile plug on the interior containment dike at the East end of the East-West Canal. This coinciding work was not paid out of the CWPPRA TV-21 budget.

Construction	$1,260,374.32
Year 1 Surveying, E&D, Construction Oversight, Asbuilts	$250,774.45
Project Total	**$1,511,148.77**

2017 Year 5 Survey – T. Baker Smith

The task included topographic surveys of the marsh creation containment areas and containment dikes, nourishment areas, and bathymetric surveys of the borrow area. The survey was a duplicate of the 2011 Survey where elevations could be compared and changes could be documented.

Project Total	**$ 88,535.80**

III. Operation Activity

a. Operation Plan

There are no water control structures associated with this project that require manual operation; therefore, no Structural Operation Plan is required.

b. Actual Operations

There are no active operations associated with this project.

IV. Monitoring Activity

a. Monitoring Goals

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS) for CWPPRA, the TV-21 Monitoring Plan was written to merge it with CRMS and provide more useful information for modeling efforts

and future project planning while maintaining the monitoring mandates of the Breaux Act. In this report, three CRMS sites (outside of the project area) are to be used to assess the effectiveness of the project along with the project-specific monitoring.

The objectives of the East Marsh Island Marsh Creation project are:

1. Create approximately 362 acres of emergent marsh in shallow open water and mud flats.
2. Create/nourish an additional 797 acres of brackish marsh with unconfined dredged sediment.
3. Reduce the future loss rate of new and existing marsh in the project area by 50%.

b. Monitoring Elements

Aerial Photography

Near-vertical color-infrared aerial photography (1:24,000 scale) will be used to measure vegetated and non-vegetated areas for the levee-contained creation and uncontained nourishment areas of the project. The photography will be obtained post-construction in the fall of 2012 and again in 2021 and 2029. The original photography will be checked for flight accuracy, color correctness, and clarity and will subsequently be archived. Aerial photography will be scanned, mosaicked, and georectified by USGS/NWRC personnel according to standard operating procedures to develop land:water analyses (Steyer et al. 1995, revised 2000).

Aerial photography will be collected for the entire coast through CRMS-*Wetlands* and will be used to evaluate TV-21 along with project specific photography. Land:Water analysis of the 1 km CRMS-*like* sites will be done using an automated classification methodology using only minimal manual delineation. Photography for the CRMS-*like* sites within the project area was acquired in 2016.

Percent land trends were calculated using Landsat Thematic Mapper (TM) data for 1985 – 2016. Linear regressions were calculated for the period of record. The variability in percent land data points around the slope illustrate the influence of various sources of environmental variance or classification error. Positive slopes indicate increasing percent land or historical land gain and negative slopes indicate decreasing percent land or historical land loss (Couvillion et al., 2017).

Salinity

Salinity data from both continuous recorder and discrete soil porewater stations are monitored to characterize the spatial variation in salinity throughout the project area. Hourly salinity and water levels (ft, NAVD88) are monitored with continuous recorders in one containment area and one nourishment area at two CRMS-like sites (TV21CR01 and TV21CR02). The CRMS-like sites were installed in September 2011 (Adequate settlement of the containment areas was required prior to construction). CRMS0523 was selected to be the hydrologic reference site. At each RSET/accretion data collection, a measurement of interstitial water salinity is collected at the boardwalk in the marsh at 10 and 30 cm. Interstitial water salinity is also determined at each of the vegetation plots, when vegetation is surveyed.

Water Level

Water level within the marsh is measured at the CRMS-like sites and reference sites listed above every hour with a water-level gauge installed within an area that is hydrologically connected to the surrounding water body. The gauge is surveyed relative to the top of the RSET (NAVD 88). Water level data is used to document the variability in water levels and duration of inundation in project and reference areas.

Average annual salinity and percent time flooded are used to develop a Hydrologic Index (HI) score (Snedden and Swenson 2012) based on the suitability of the site in maximizing vegetation productivity according to its specific marsh class (swamp, fresh, intermediate, brackish, and saline). The HI score (between 0 and 100) corresponds to the percent of maximum vegetation productivity expected to occur if the separate effects of salinity and inundation interact in a multiplicative fashion on vegetation productivity.

Emergent Vegetation

Emergent vegetation parameters are evaluated at each CRMS-like site using techniques described in Folse et al. (2012) to describe species composition, richness, and relative abundance. Annually in late summer at each site, data are collected from ten, 4-m^2 sample plots randomly established along a 282.8 m transect that crosses diagonally through a 200-m × 200-m sampling area in the middle of the site.

Individual species' cover data were summarized according to the Floristic Quality Index (FQI) method (Cretini et al. 2011). The FQI assigns a low score to invasive species indicative of disturbance and a high score to native species indicative of stability. The two CRMS-like sites inside and 3 CRMS sites outside (522, 523, 524) the project area were used for this report. Data from 2011 - 2016 will be presented.

Submerged Aquatic Vegetation (SAV)

To document changes in the occurrence of SAV, two ponds adjacent to the project area were monitored using the rake method to determine if a breach into the northernmost pond had an effect on SAV abundance (Chabreck and Hoffpauir 1962) (figure 2). No ponds were monitored within the project area. Three transects (minimum 20 samples/transect) were established across open water in each pond. Submerged aquatic vegetation was sampled repeatedly along each transect by dragging a garden rake on the pond bottom for one second. The presence or absence of vegetation was recorded for each sample to determine the percent occurrence on a transect (% occurrence = (number of samples with SAV/number of samples) × 100). When vegetation was present, the species present was recorded in order to determine the frequencies of individual species (Nyman and Chabreck 1996). SAV was monitored post-construction in the fall of 2012 and 2013.

Soil Properties

Soil cores were collected to describe soil properties (soil pH, salinity (EC), bulk density, moisture, % organic matter, wet/dry volume, and texture (Particle Size Distribution) analysis. Three, 4" (10.16-cm) diameter cores were collected to a depth of 24 cm and divided into 6, 4-

cm sections at each site. The soil was processed by the Department of Agronomy and Environmental Management at Louisiana State University. Soil cores were collected at 6 sites, one within each contained site and 4 in the surrounding uncontained deposition sites. Suitable reference cores (same quality or marsh type) were collected from 3 nearby CRMS sites outside the project area. Cores were collected for the project sites in 2011 and 2016 and will be collected again in 2020 and 2030. Soil cores were only collected at the nearby CRMS sites during station establishment in 2005-2007. The samplings in 2011 and 2016 will be presented for the project sites in this report.

Soil Surface Elevation Change

Soil surface elevation change utilizing a combination of rod-surface elevation tables (RSET) and vertical accretion from feldspar horizon markers are being measured twice a year at each site. These data will be used to describe general components of elevation change and establish accretion/subsidence rates. The RSET was surveyed to a known elevation datum (ft, NAVD 88) so it could be directly compared to other elevation variables such as water level. Data collected over at least 5 years was used to calculate rates for the project sites and reference CRMS sites; therefore the displayed elevation change rates are an estimation of that temporal trend.

Borrow Area (Dissolved O_2)

Dissolved oxygen level monitoring in the East Cote Blanche Bay borrow area and a reference area (located within one-quarter to one-half mile of the borrow site and between the borrow site and the east end of Marsh Island) was performed post-construction to determine if hypoxic conditions occurred in the borrow area during the refill period. Monitoring was to be performed in years 2011 2012, 2013 and 2016 unless prior refill of the borrow area occurred. The ratio of the dissolved oxygen content (ppm) to the potential capacity (ppm) will give the percent saturation, which is an indicator of water quality. A sampling period consisted of systematic monitoring of the borrow and reference areas for hypoxia (dissolved oxygen <2 mg l-1) in bottom waters for 60 days in the summer from late July through September. This was accomplished by installing a continuous recorder adjacent to a buoy in the borrow area and in the nearby reference area. This information will help to provide recommendations on borrow area design in the future.

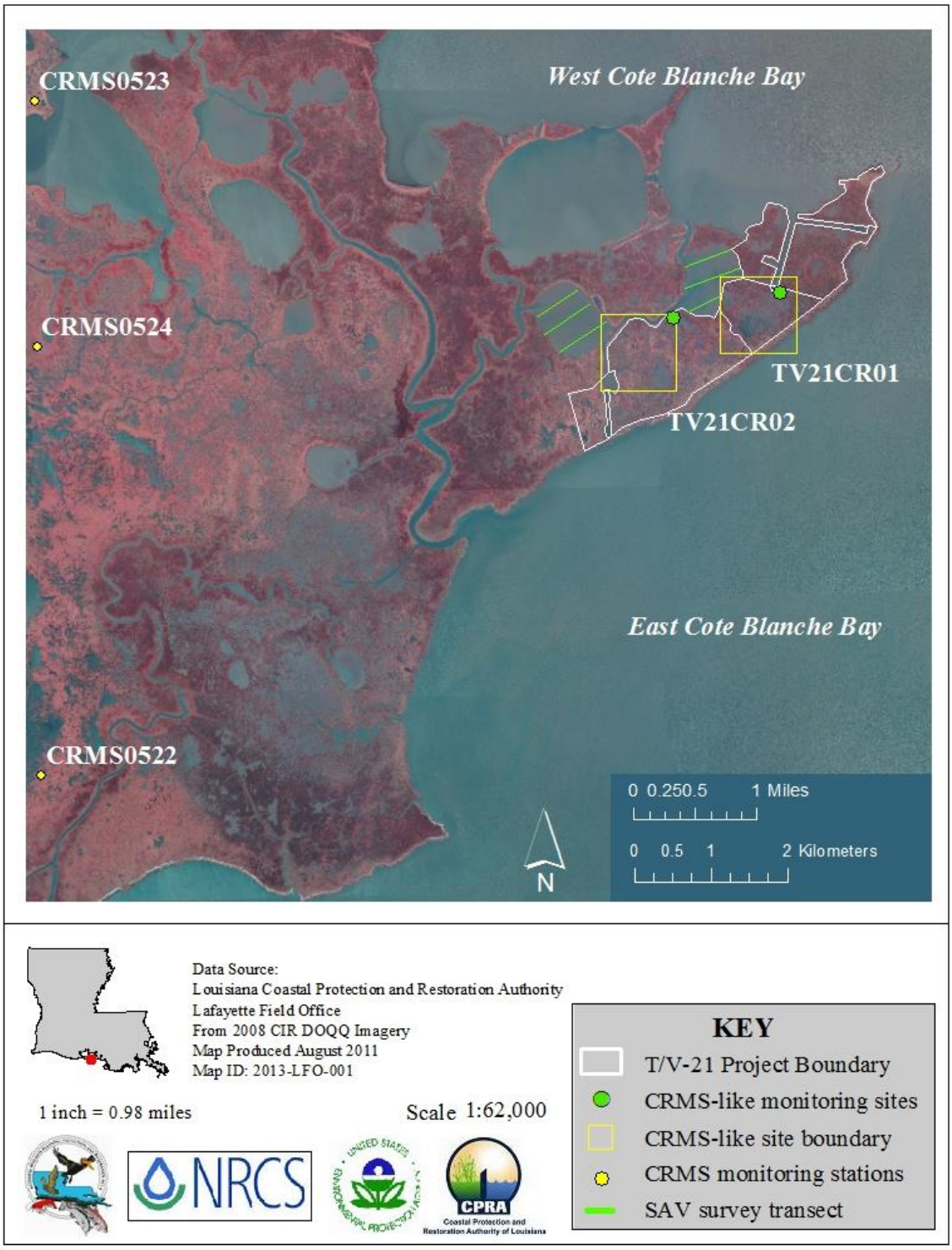

Figure 2. Location of CRMS-like monitoring sites within the East Marsh Island Marsh Creation (TV-21) project area, SAV transects and nearby CRMS sites to be used for comparison.

IV. Monitoring Activity (continued)

c. Monitoring Results and Discussion

i. Aerial Photography

Post-construction land/water analysis was completed for the 2012 aerial photography (Figure 3). Results indicated 89.13% land and 10.87% water within containment area 1, 91.01% land and 8.99% water within containment area 2, and 85.31% land and 14.69% water within the nourishment areas. Future analysis will help to determine the project's effect on land change.

For the two CRMS-*like* sites in the project area, land/water analysis was completed for the 2016 digital imagery (Figure 3b and 3c). Results indicated 85.07% land and 14.93% water within TV21-CR01 and 84.30% land and 15.70% water within TV21-CR02.

The general land change trend within the project area prior to construction was slightly negative (-0.07% per year) from 1985-2010 (Figure 3d). Incorporating the 2010-2016 data, which includes the post-construction satellite imagery, causes the general trend to become slightly positive (0.06% per year), reflecting the positive impact of the marsh creation and nourishment in the project area.

ii. Salinity

Salinities at the project and reference area recorders were very similar in 2012-2016, averaging around 5 ppt (Figure 4a). Seasonal spikes in salinity occurred in the late summer/fall months occasionally elevating salinities in the project area to 7-10 ppt, but otherwise, salinities primarily remained below 5 ppt. In August of 2012 Hurricane Isaac made landfall near the mouth of the Mississippi River, elevating salinities above 25 ppt in the project area. By the beginning of 2013, salinities dropped back down to normal.

Average weekly salinities were compared between the project stations to determine if a difference in salinity occurred between the two. A non-parametric one way median analysis showed that salinities were not statistically different across the period of record between TV21CR01 and TV21CR02 (x^2=0.0.205, p=0.65). This same test also showed there was not a significant difference between salinities in the project area recorders and the recorder at the reference station CRMS0523 (x^2=0.70, p=0.40).

Yearly means of interstitial water salinity for the project stations and CRMS reference stations 522, 523 and 524 are presented in figures 4b and 4c. Porewater salinities have consistently been between 5 and 10 ppt through all years at the reference CRMS sites. Nourishment area site TV21CR02 saw elevated salinities in 2011 and 2012 but has since tracked well with the CRMS sites. Salinities at TV21CR01 in the containment area rose continuously through 2014 to above 10 ppt, but have since dropped to the level of the other sites. Slightly higher interstitial salinities at the project sites, particularly in the containment area until 2014, may be due to leaching of salts from the soil due to the soils being dredged from the East Cote Blanche Bay bottom.

Increased rainfall in recent years has benefited the project area and worked to freshen the porewater salinities.

iii. Water Level

Water levels were nearly identical in both project sites and CRMS0523, differing only during extreme low water events, such as the landfall of Hurricane Isaac (Figure 5a). A non-parametric one way median analysis determined there was not a significant difference in water between the two project sites (x^2=0.994, p=0.319), nor between the project sites and reference site CRMS0523 (x^2=0.1753, p=0.675).

TV21CR02 and CRMS0523 both scored high and very similarly on the Hydrologic Index (above 80 in all years), while TV21CR01 scored considerably lower in all years except 2016 (Figure 5b). Though the 3 sites had very similar annual salinities and water levels, TV21CR01 has a higher marsh elevation, resulting in a much lower percent time flooded then the other two stations and thus a lower HI score.

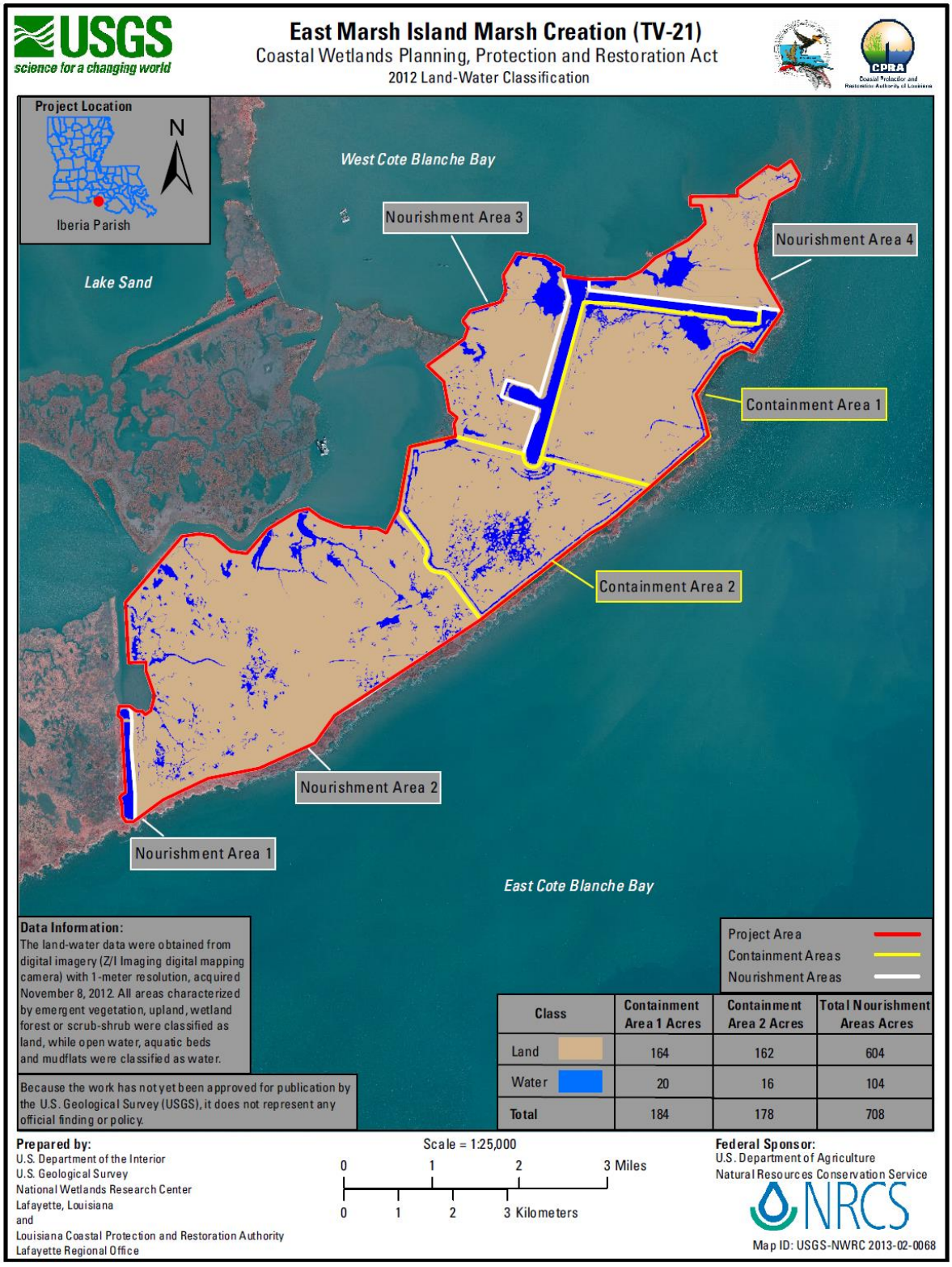

Figure 3a. East Marsh Island Marsh Creation (TV-21) project 2012 land/water analysis.

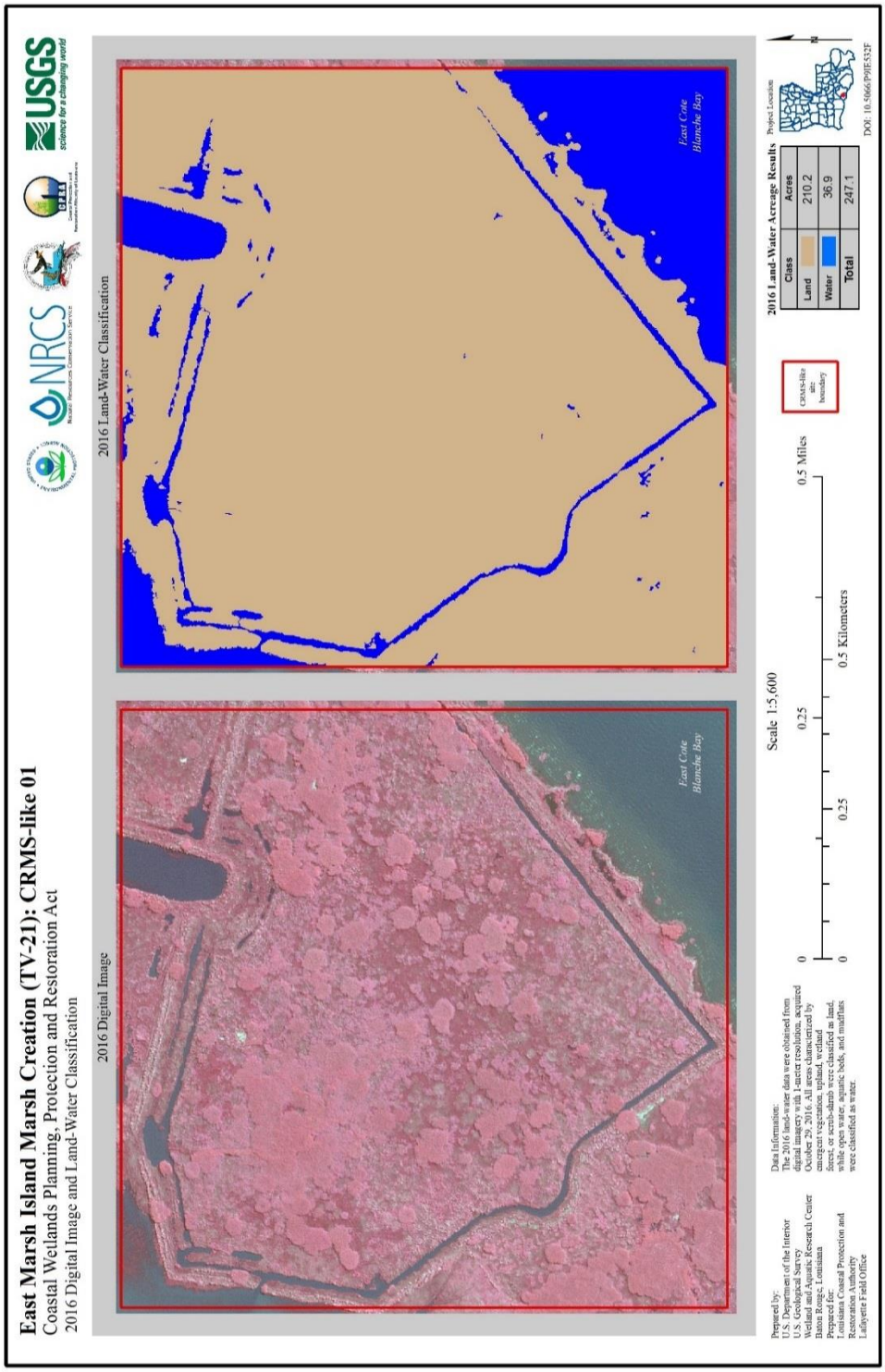

Figure 3b. East Marsh Island Marsh Creation CRMS-like site TV21-CR01 2016 land/water analysis.

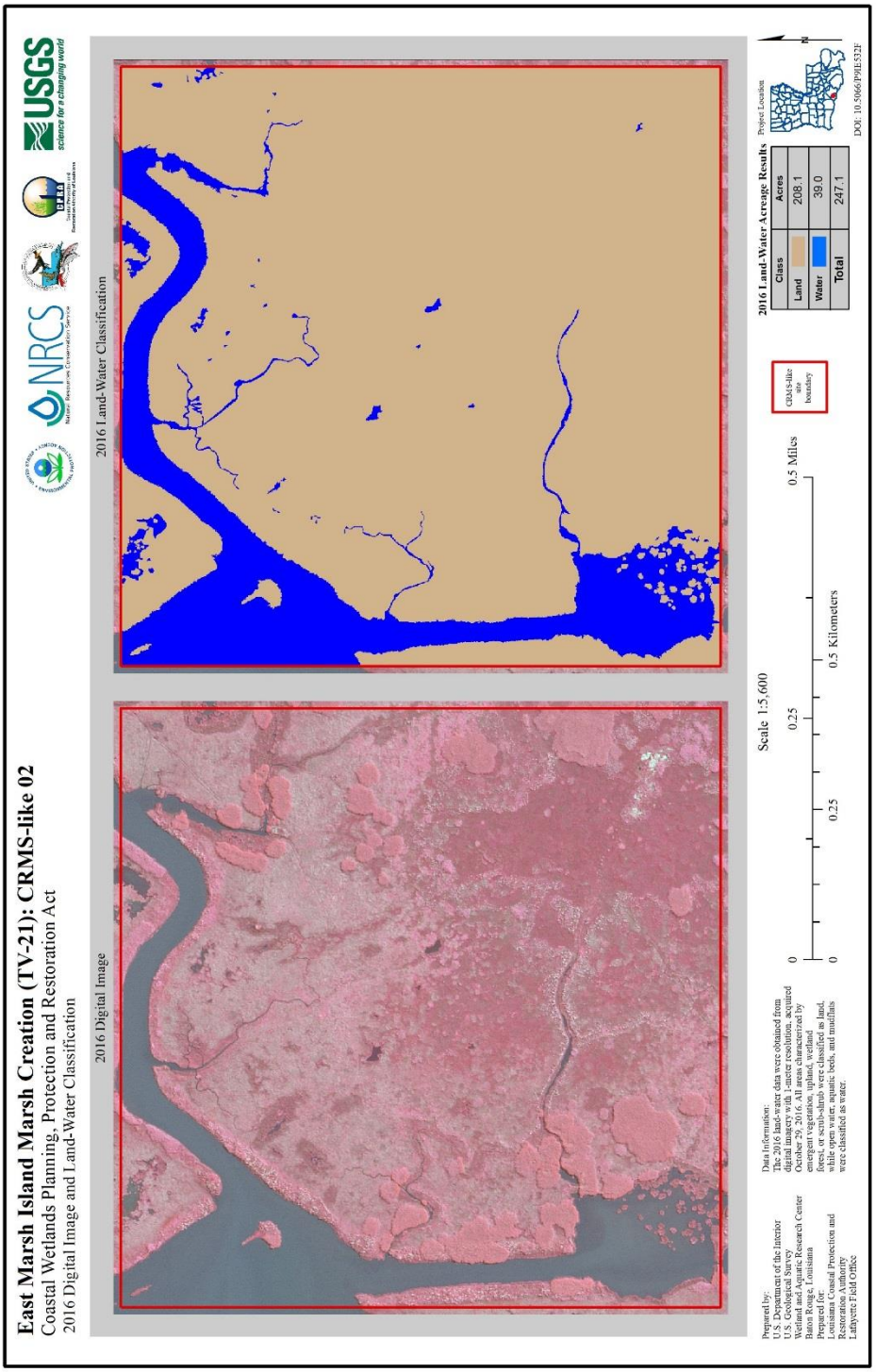

Figure 3c. East Marsh Island Marsh Creation CRMS-like site TV21-CR02 2016 land/water analysis.

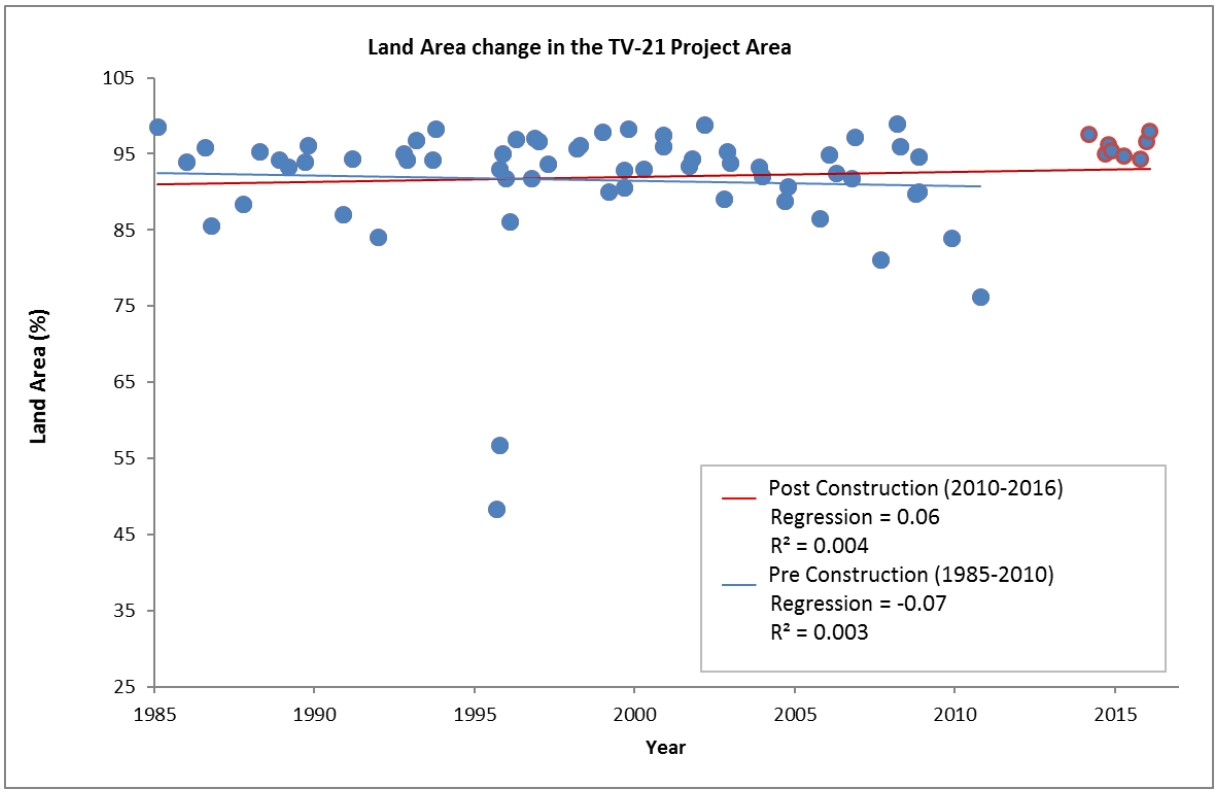

Figure 3d. Project scale percent land change for TV-21. Percent land values are displayed for all cloud free TM images available for 1985-2016. The red line depicts the percent land trend for the entire period of record. The blue line depicts the percent land trend for the pre-construction time period only. Percent land calculated as percent land of total project area. See Couvillion et al. 2017.

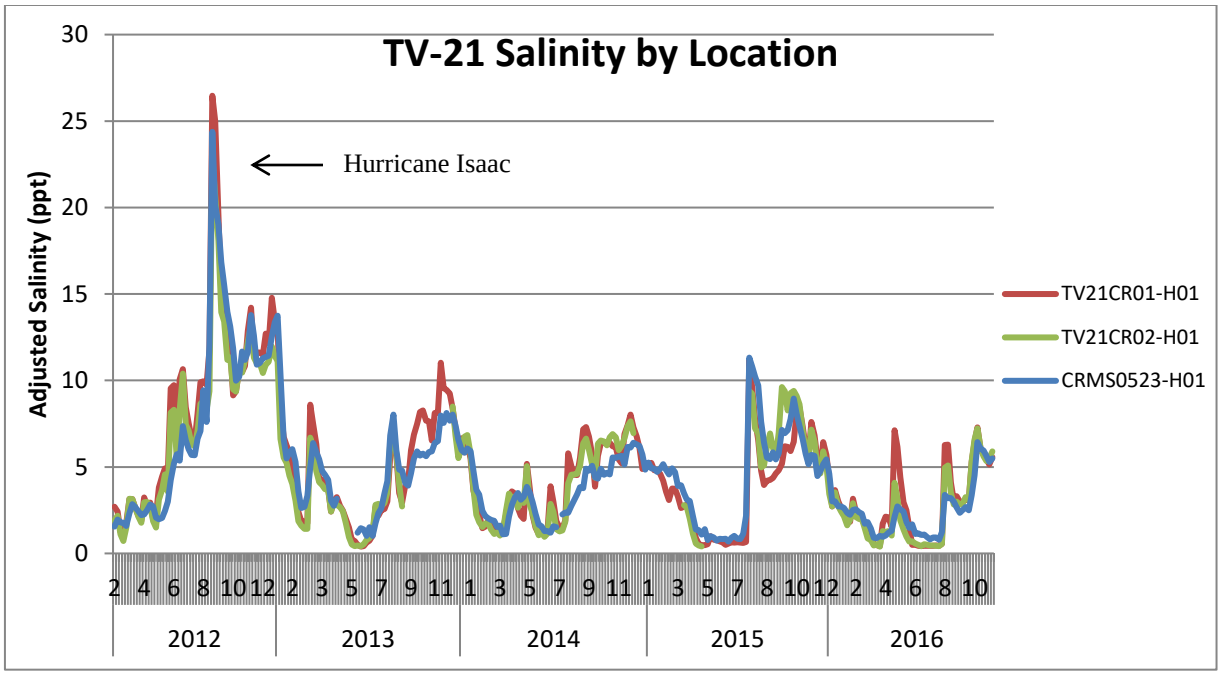

Figure 4a. Weekly means of salinity data collected at project and CRMS reference sites.

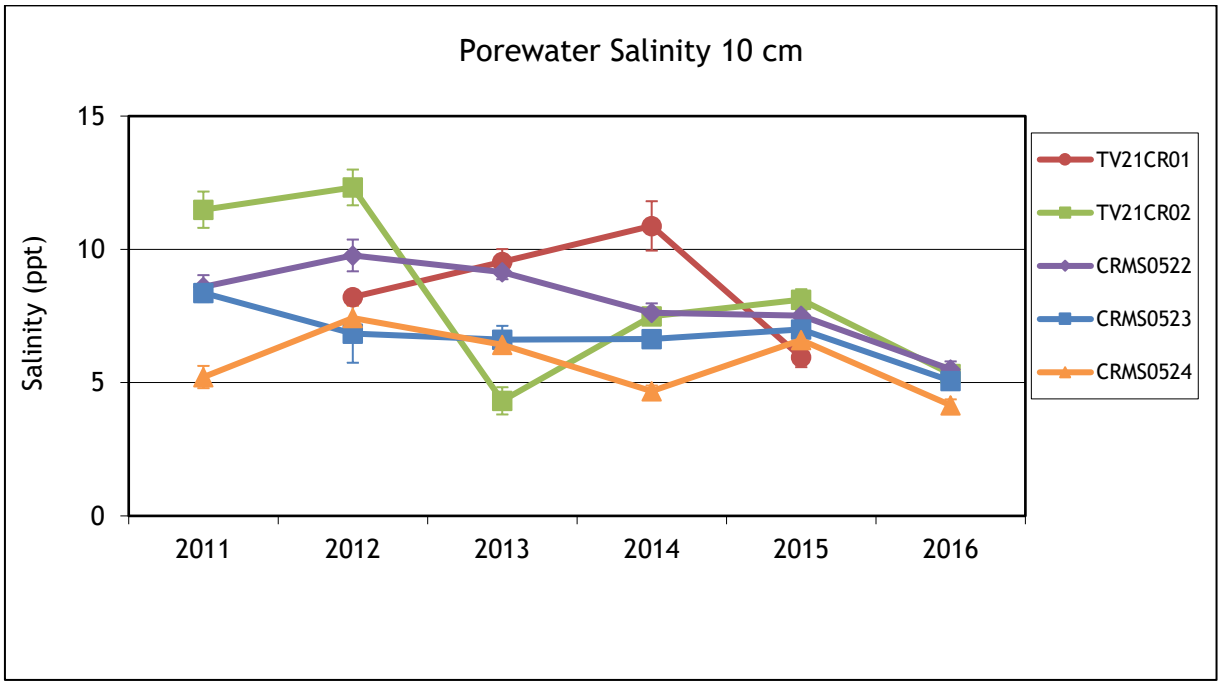

Figure 4b. Yearly Means of Interstitial water salinity at 10 cm below the soil surface at project and CRMS reference sites. Mean ± SE.

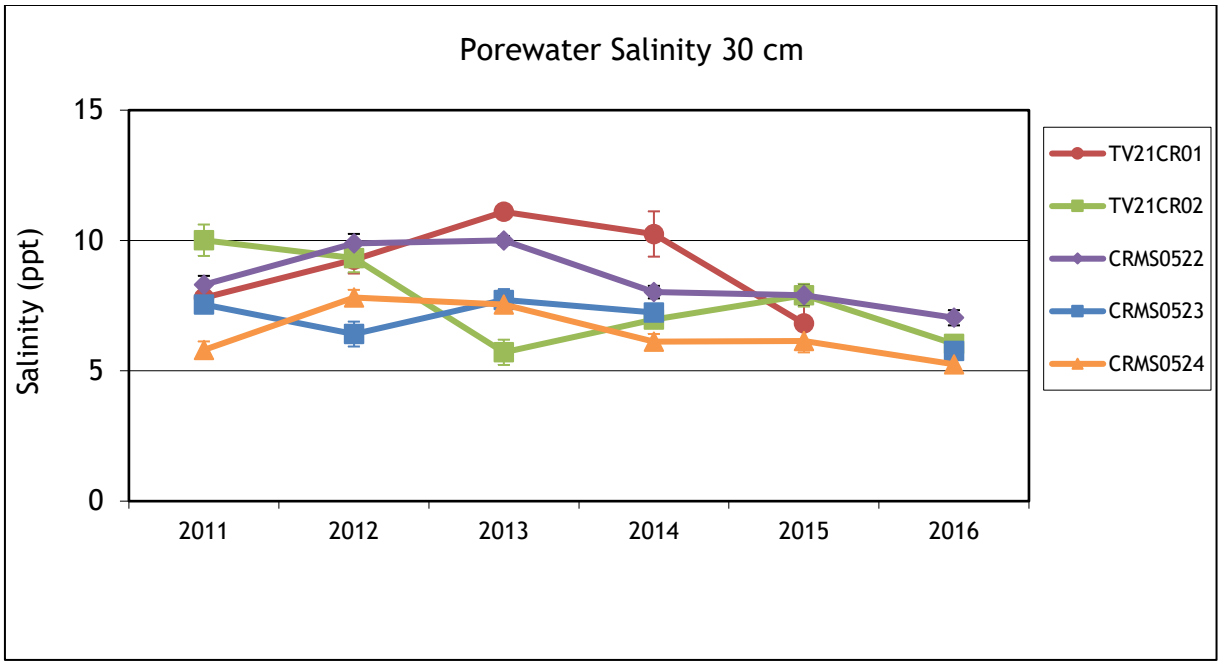

Figure 4c. Yearly Means of Interstitial water salinity at 30 cm below the soil surface at project and CRMS reference sites. Mean ± SE

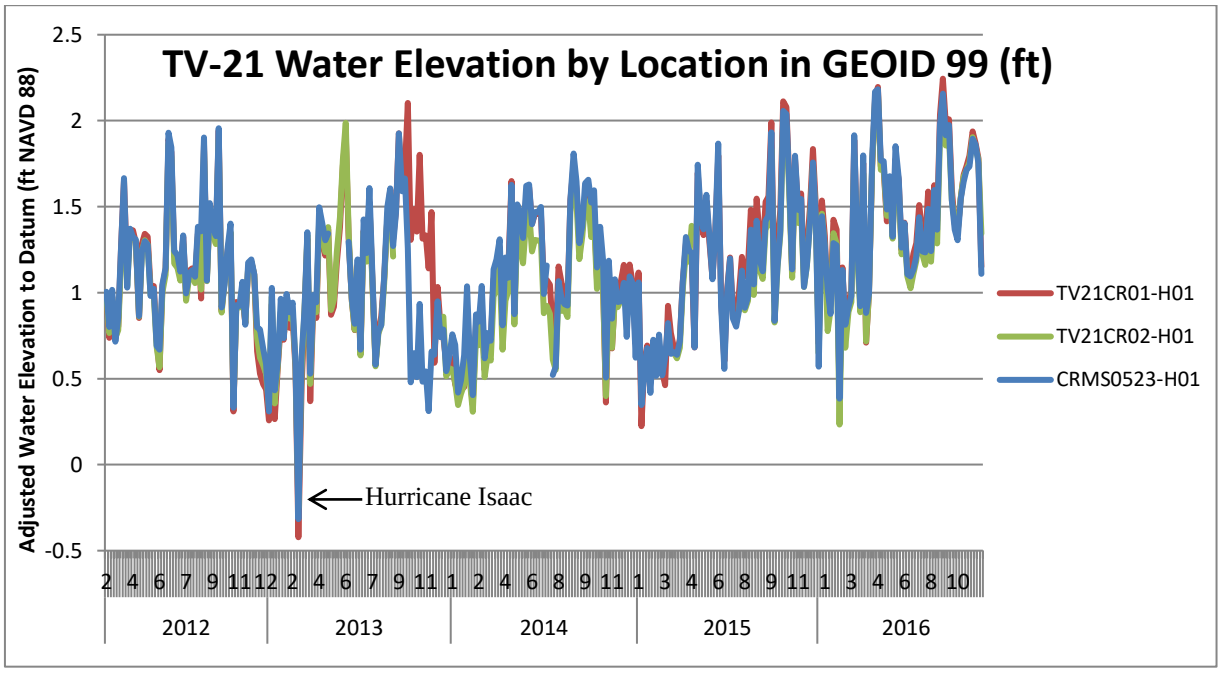

Figure 5a. Weekly means of water level data collected at project and CRMS reference sites.

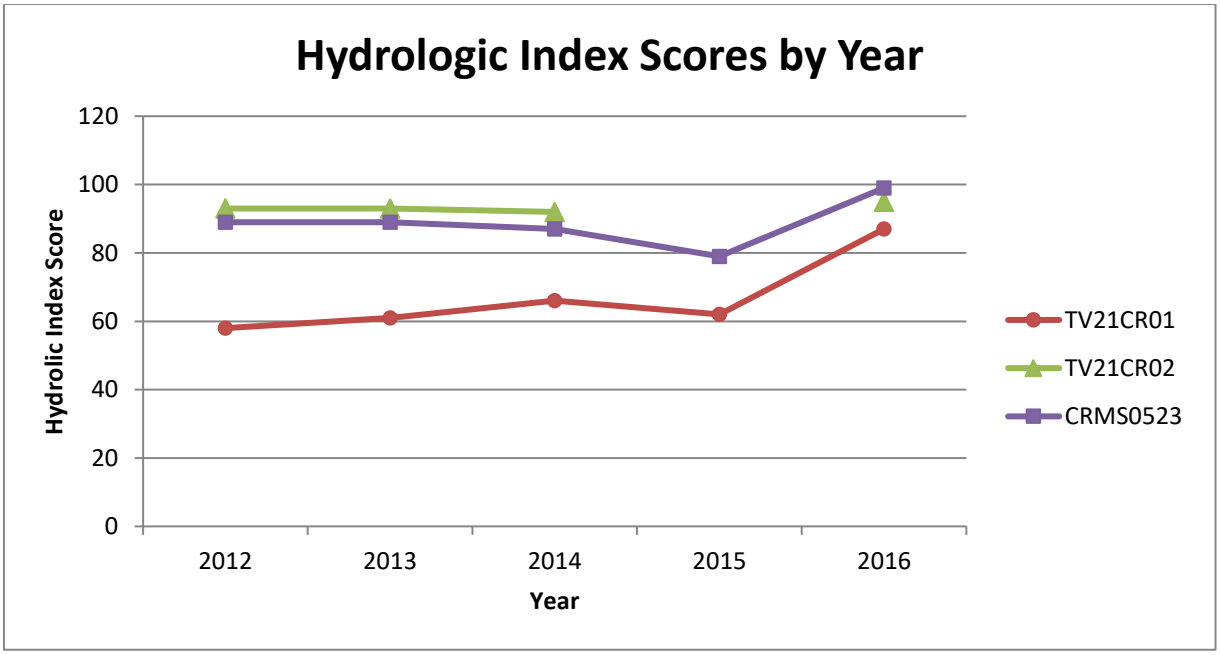

Figure 5b. Hydrologic index scores by year for project and reference stations.

iv. Emergent Vegetation

Containment area 2 (TV21-CR01) slowly vegetated through 2013, then increased in cover to above 70% in 2014-2016 (Figure 6a). The containment area has seen a large expansion of *Phragmites australis* and *Bacharis halimifolia*, likely due to the site's higher elevation. Vegetation in nourishment area 2 (TV21-CR02) was doing quite well in the first year after construction, but declined drastically in both cover and FQI in 2012 due to heavy herbivory damage from nutria. By 2012, the nutria had eliminated almost all of the *Schoenoplectus americanus* (a preferred food source) and *Spartina alterniflora* from the area, which were dominant species in the 2011 survey. By 2013, the area had recovered in percent cover of *Spartina patens* and *S. americanus* and also saw the appearance of a large amount of *Eleocharis parvula*, though this species disappeared from the area by 2014. A minor decrease in cover and FQI again occurred in 2016, likely due to the heavy flooding in August immediately prior to the vegetation survey.

Vegetation at the reference stations has been stable since 2008, with cover values above 70% through most years sampled (Figures 6b – 6d). Like the project nourishment area site, nutria did considerable damage to the CRMS reference sites as well in 2012. Like the project site, recovery had taken place by 2013 at CRMS0523 and 0524, but not until 2014 at CRMS0522. The vegetation assemblages at the reference sites are similar to the vegetation at TV21-CR02 and are indicative of a brackish marsh, being dominated by *S. patens* and *S. americanus* with small amounts of *Distichlis spicata*.

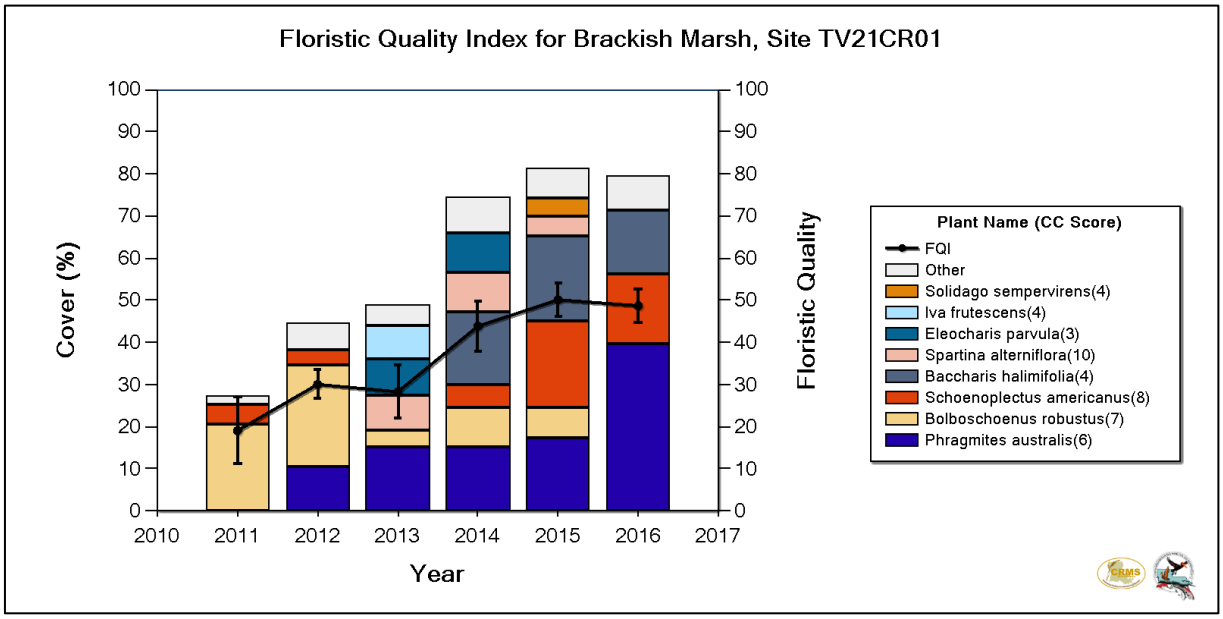

Figure 6a. Percent coverage and floristic quality index of species collected from station TV21-CR01 within the project area in years 2011-2016. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

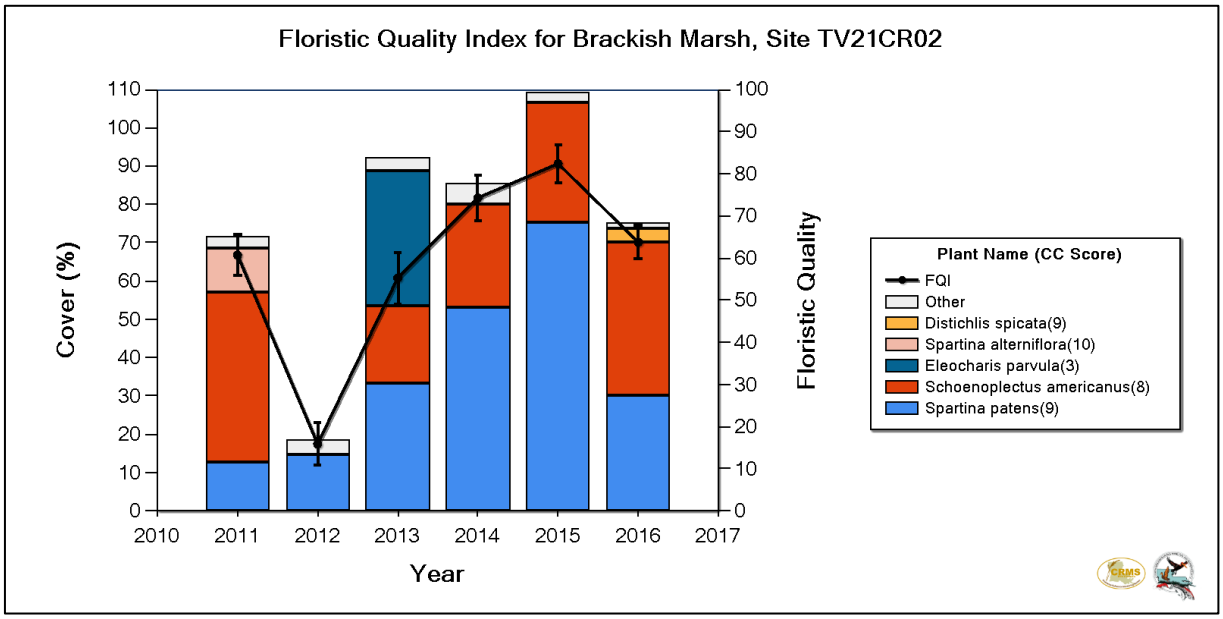

Figure 6b. Percent coverage and floristic quality index of species collected from station TV21-CR02 within the project area in years 2011-2016. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

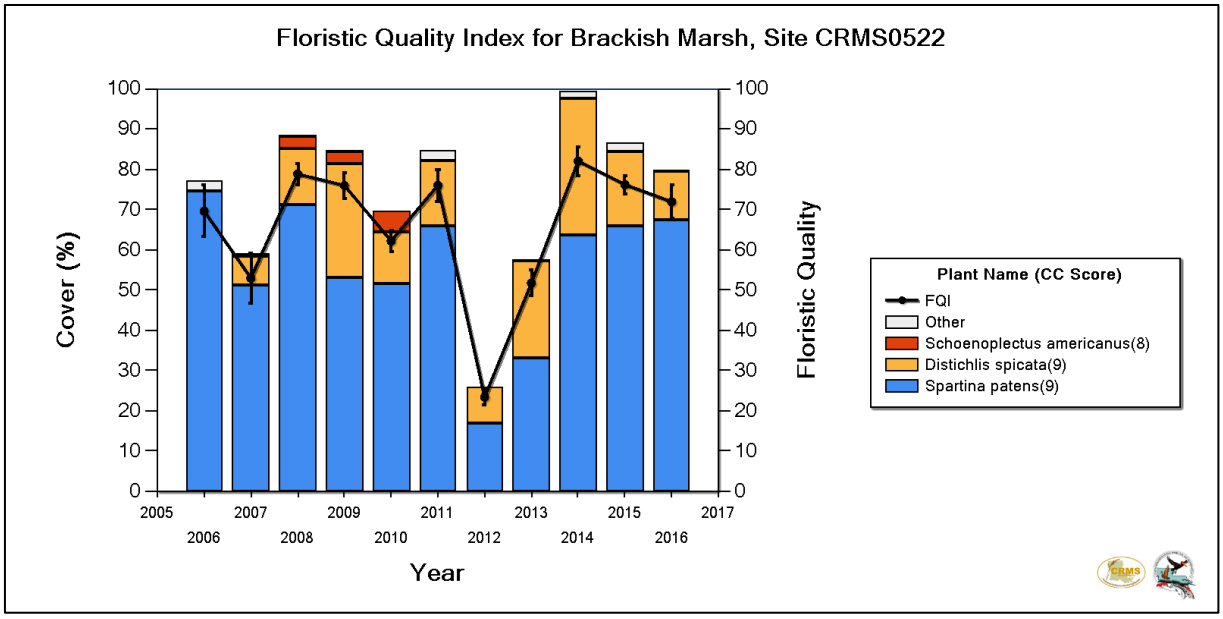

Figure 6c. Percent coverage and floristic quality index of species collected from reference site CRMS0522 in years 2006 - 2016. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

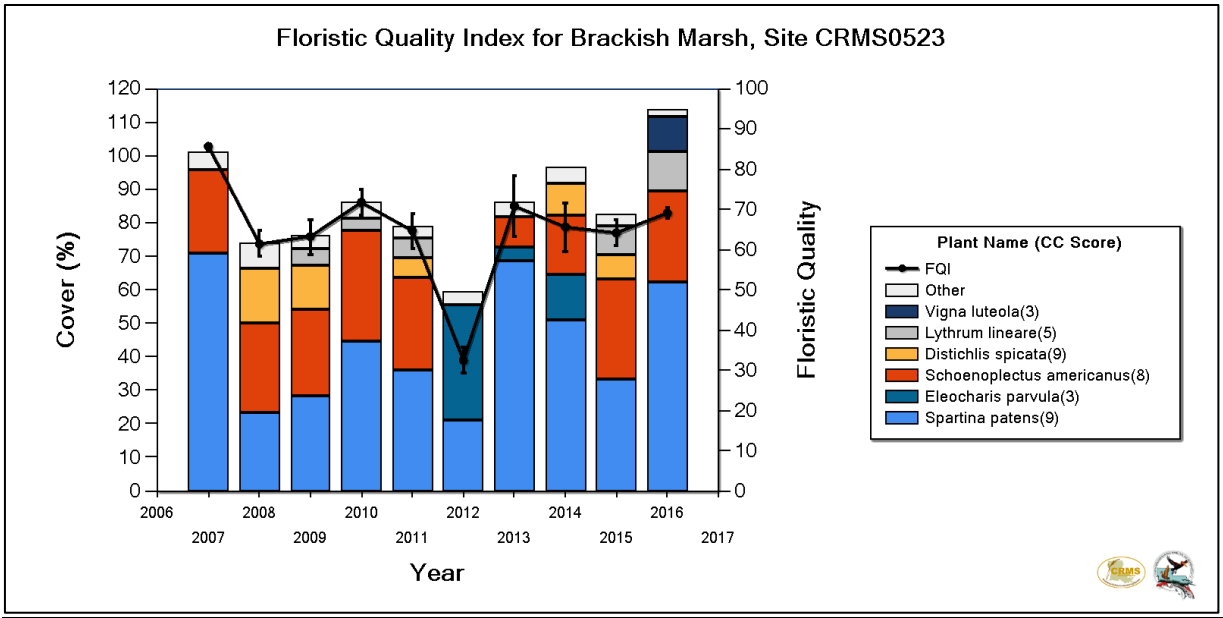

Figure 6d. Percent coverage and floristic quality index of species collected from reference site CRMS0523 in years 2007 - 2016. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

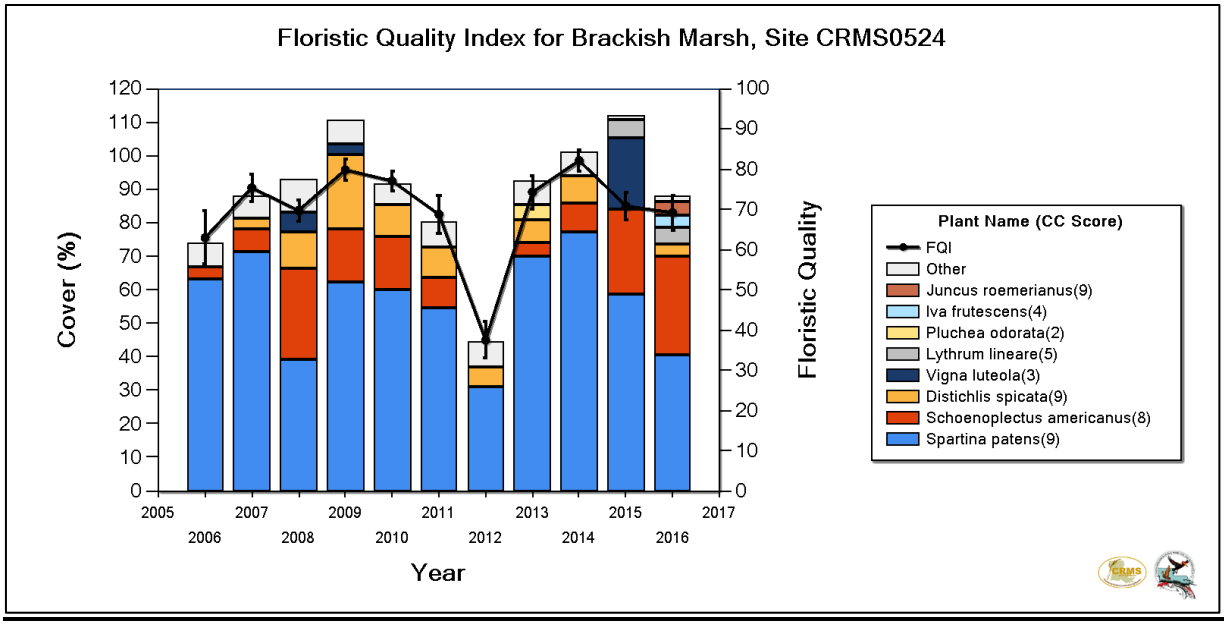

Figure 6e. Percent coverage and floristic quality index of species collected from reference site CRMS0524 in years 2006 - 2016. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

v. Vegetation Plantings

Dr. Herry Utomo established an aerial seeding trial using different application rates of Poly C15 *Spartina alterniflora* seed on April 25, 2011. A 10 acre plot in containment area 2 was reserved for the trial and consisted of three planting strips with three different seeding rates along each strip (Figure 7). Dr. Utomo was able to identify clumps of thriving *S. alterniflora* from the trial in September 2011, based on plant type, stem color, plant height and heading time, indicating that the seedings were successful.

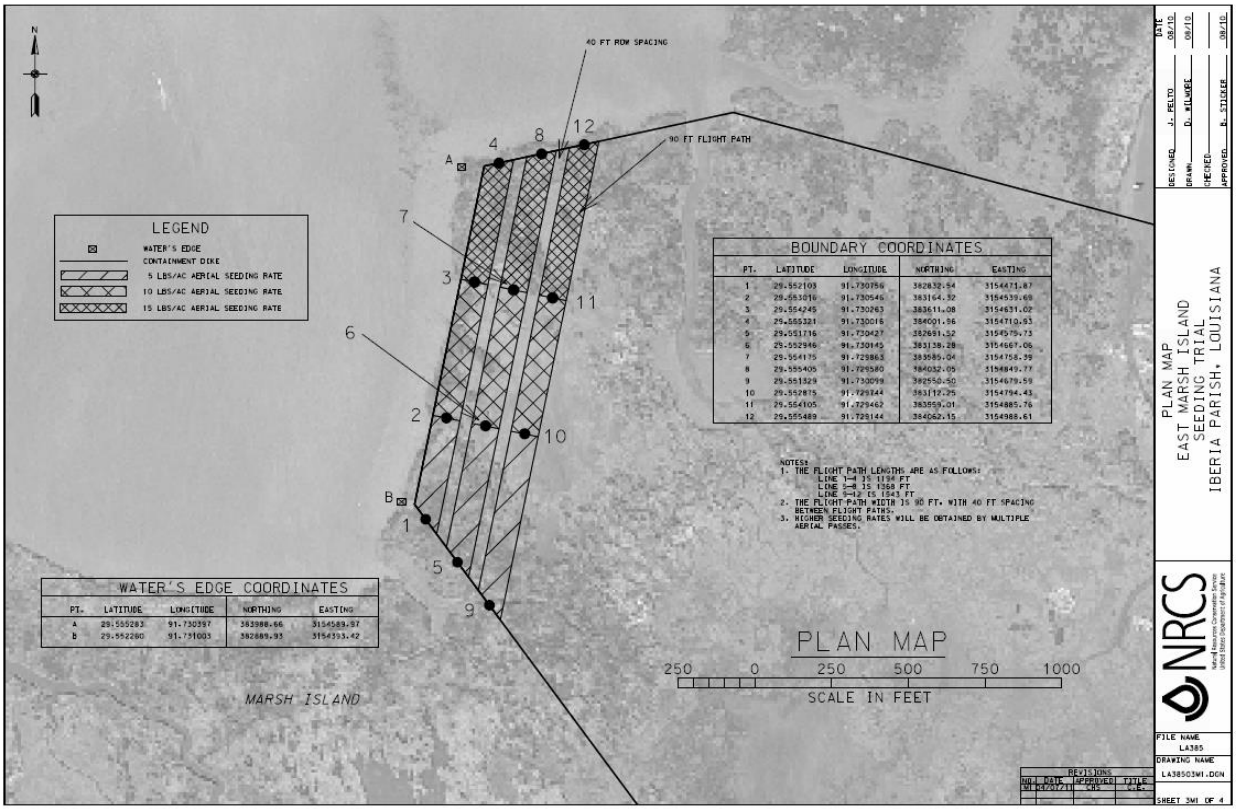

Figure 7. Dr. Herry Utomo's aerial seeding plan to test different application rates of Poly C15 *Spartina alterniflora.*

vi. Submerged Aquatic Vegetation (SAV)

Post-construction SAV sampling surveys were performed in September of 2012 and 2013. A total of 6 transects in two ponds (3 each) near the project area were sampled as described in the monitoring elements section. There were 40 samples collected per transect. Average pond depth was 0.4 ft. No SAV were present at any sampling station on either survey. The absence of SAV could be due to the shallow pond depth, as the ponds could become mudflats at low tides as well as the effects of wind, which could cause high turbidity. This turbidity could reduce light levels in the ponds, inhibiting SAV growth. The absence of SAV could also be related to yearly variations caused by climate. SAV populations were very low as well in the surrounding TV-14 project and reference areas during 2006-2013 surveys.

vii. Soil Properties

Soil samples were collected in each of the containment and nourishment areas, except nourishment area 1, in September 2011 and 2016 (Figures 8a and 8b). The soil properties data were sampled in 4 cm increments. Soil properties were averaged by area type for the containment and nourishment areas, except for nourishment area 2 due to the sites proximity to the Gulf of Mexico shoreline which distorted the 2011 sample. This site was analyzed separately from the other nourishment areas.

As would be expected, higher bulk densities occurred in the containment areas in both samples, due to the high mineral content of the spoil, which was deposited more heavily in the containment areas. The higher bulk density at NA2 in 2011, which was collected from the southern end of nourishment area 2 near the gulf shoreline, was probably due to overwash events from the gulf which deposited new mineral material. The bulk density in the upper 8 cm of the nourishment areas cores decreased from 2011 to 2016, but increased in the lower 2/3s likely due to buildup of organic matter on the surface and leaching of mineral sediments from the dredge material. The reverse occurred in percent organic matter (OM) at the nourishment area sites, except nourishment area 2 which increased significantly throughout the soil profile. A slight increase in OM also occurred throughout the containment area soil cores, but was still only around 10% in 2016.

For comparison, figures for mean bulk density and percent organic matter at the 3 reference CRMS sites are presented in figures 8c and 8d. Bulk density profiles were similar for all 3 sites and were less than the project area sites (<0.3 g/cm^3). The reference CRMS sites were also much more organic than the project area sites. CRMS0524, located in the interior of marsh island, had the highest organic matter content out of the 3 sites (~50% at 4-20 cm).

For the most part, pH readings were slightly basic throughout all of the soil profiles in the project area during the initial sampling (Figure 8e). As the soils have become more organic over time, the pH of the soils has become more acidic due to the release of organic acids during decomposition, particularly in the upper portion of the soil profile.

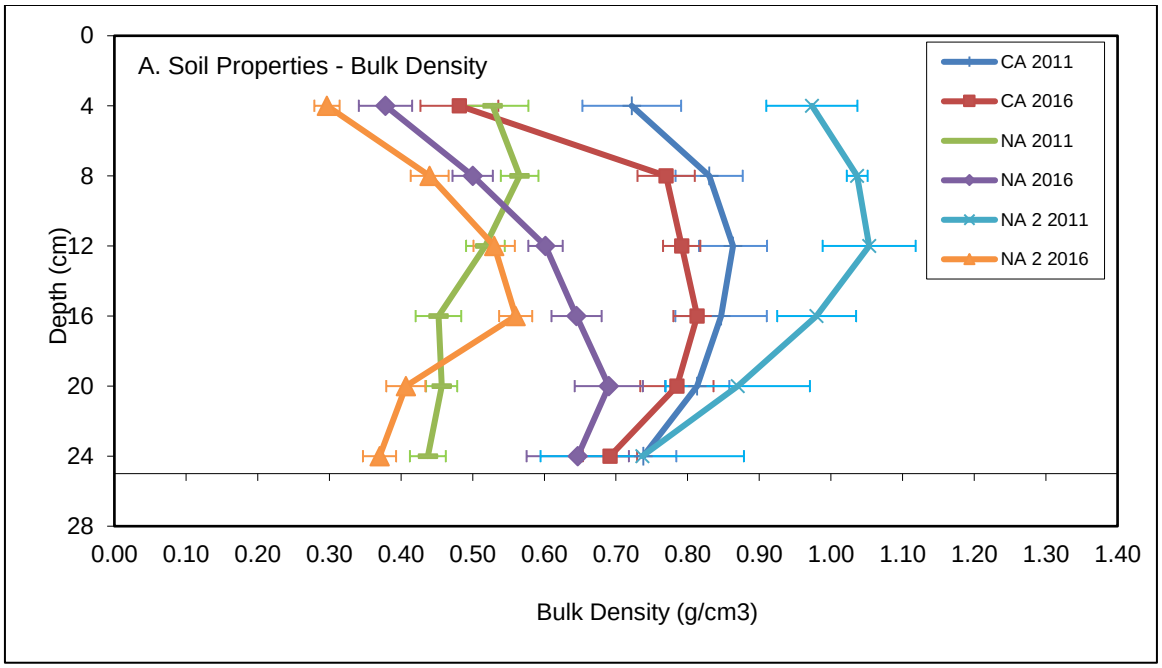

Figure 8a Soil bulk density at containment and nourishment areas collected in TV-21 project area in 2011 and 2016. Mean ± SE.

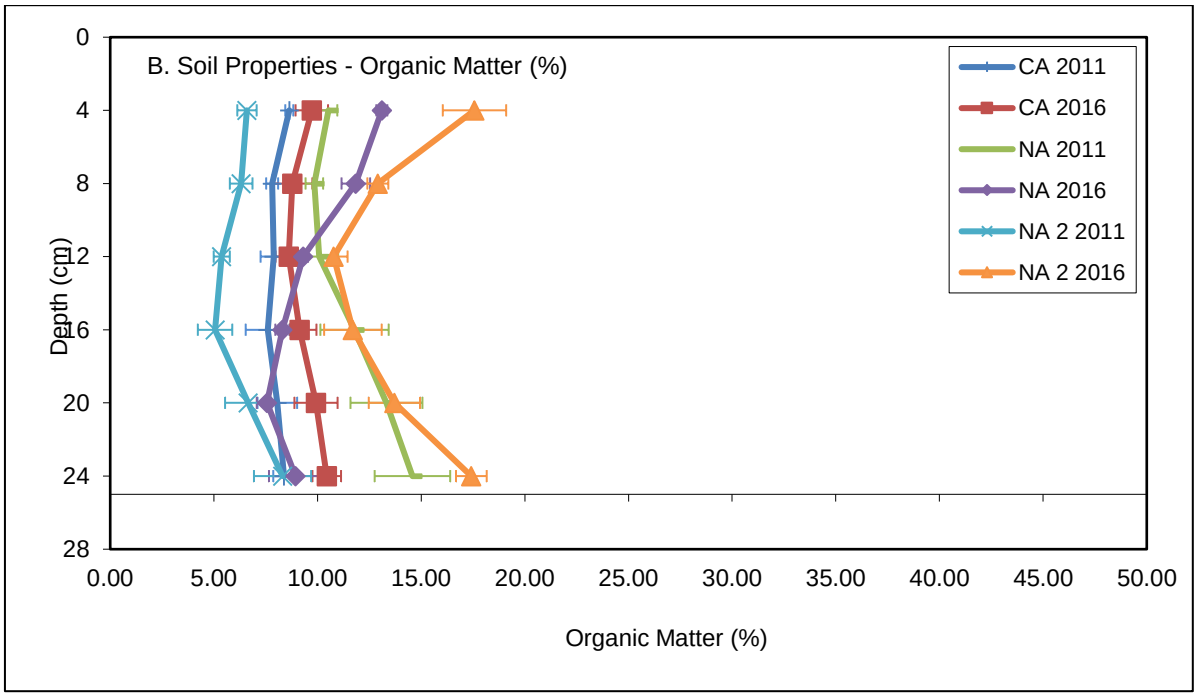

Figure 8b. Soil organic matter at containment and nourishment areas collected in TV-21 project area in 2011 and 2016. Mean ± SE.

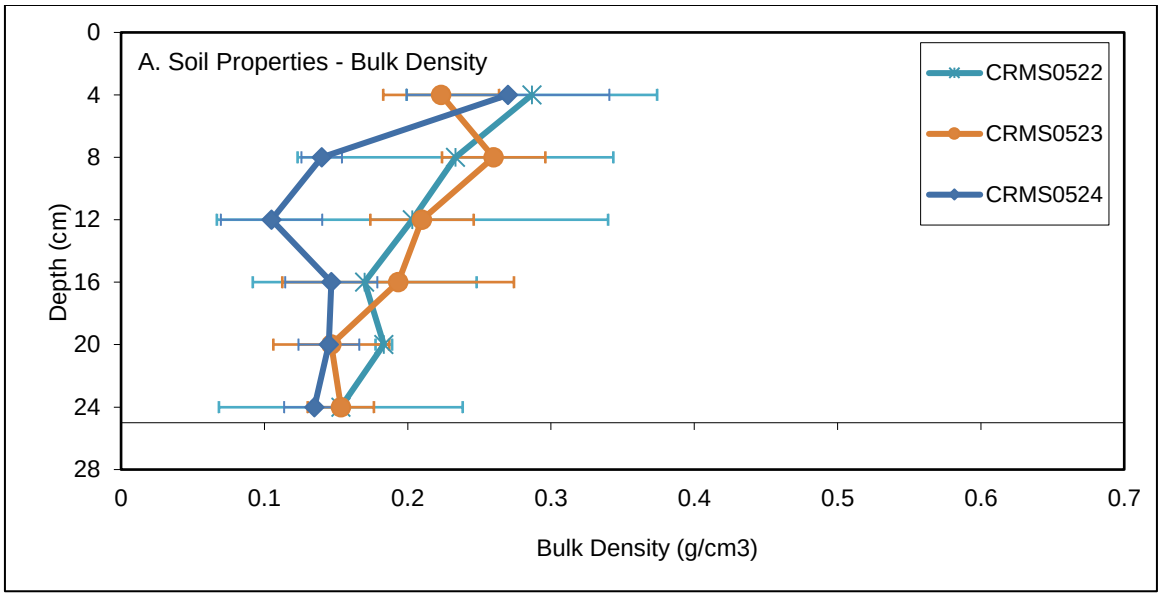

Figure 8c. Soil bulk density collected at reference CRMS-*Wetlands* stations. Mean ± SE.

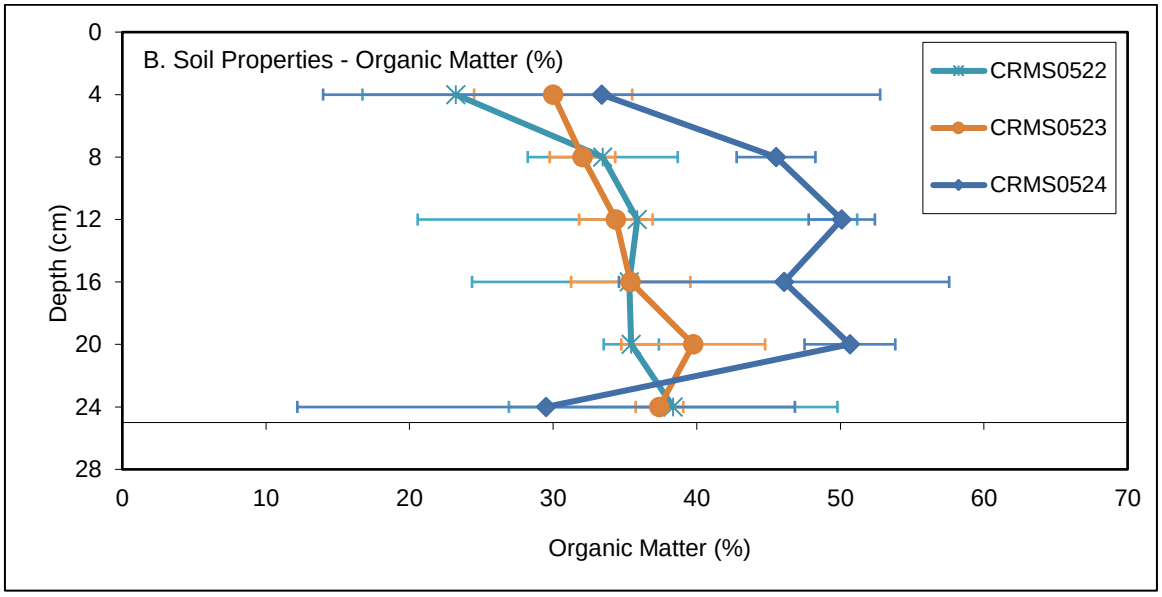

Figure 8d. Soil organic matter collected at reference CRMS-*Wetlands* stations. Mean ± SE.

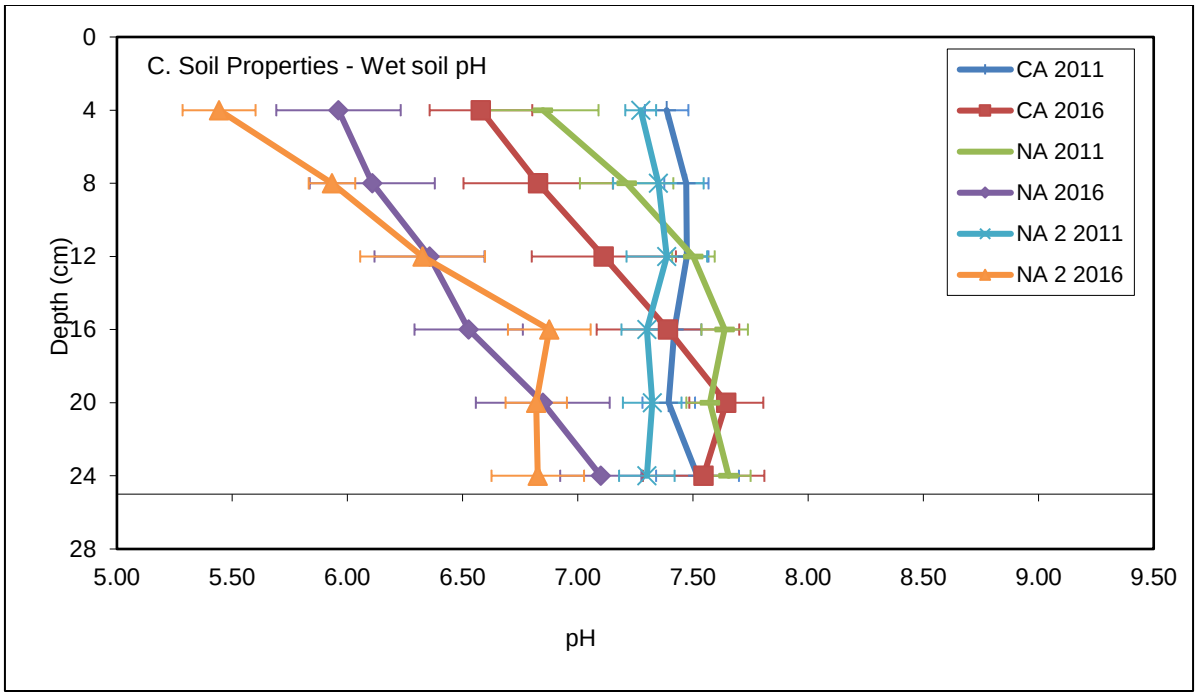

Figure 8e. Wet soil pH at containment and nourishment areas collected in TV-21 project area in 2011 and 2016. Mean ± SE.

viii. Soil Surface Elevation Change

The cumulative surface elevation change (SEC) rate within containment area 2 (TV21CR01), as expected, has been negative over the entire monitoring period, due to the settlement of the fill material (Table 1). The settlement period lasted through the spring of 2016, with overall settlement being approximately 12 cm (Figure 9). The spring to fall 2016 time period showed a positive gain in elevation with an associated positive vertical accretion (VA) rate for the first time since monitoring on the project began. SEC within nourishment area 2 (TV21CR02) showed an initial loss in elevation from Fall 2012 to Spring 2013 that could be attributed to both consolidation of the spoil material and nutria disturbance of the soil surface. Beyond this time period, though, SEC and VA rates have been very similar to the average rates at the three reference CRMS sites (Figure 9). Cumulative SEC, VA, and shallow subsidence rates are also nearly identical to the average rates of the three CRMS sites (Table 1), suggesting that the nourishment area is behaving functionally like the surrounding area marshes.

Table 1. Vertical accretion, surface elevation, and shallow subsidence change rates collected at TV-21 project sites and reference CRMS sites (Rates were averaged for CRMS0522, 523, and 524 ± 1 SE).

Site	Data Collection Period	Rates of Change (cm/yr)		
		Surface Elevation	Vertical Accretion	Shallow Subsidence
TV21CR01	Mar 2012-Sep 2016	-2.49	-0.48	2.01
TV21CR02	Mar 2012-Sep 2016	0.13	0.95	0.82
Average of Ref CRMS sites	April 2007-Nov 2016	0.14 ± 0.05	0.90 ± 0.16	0.75 ± 0.14

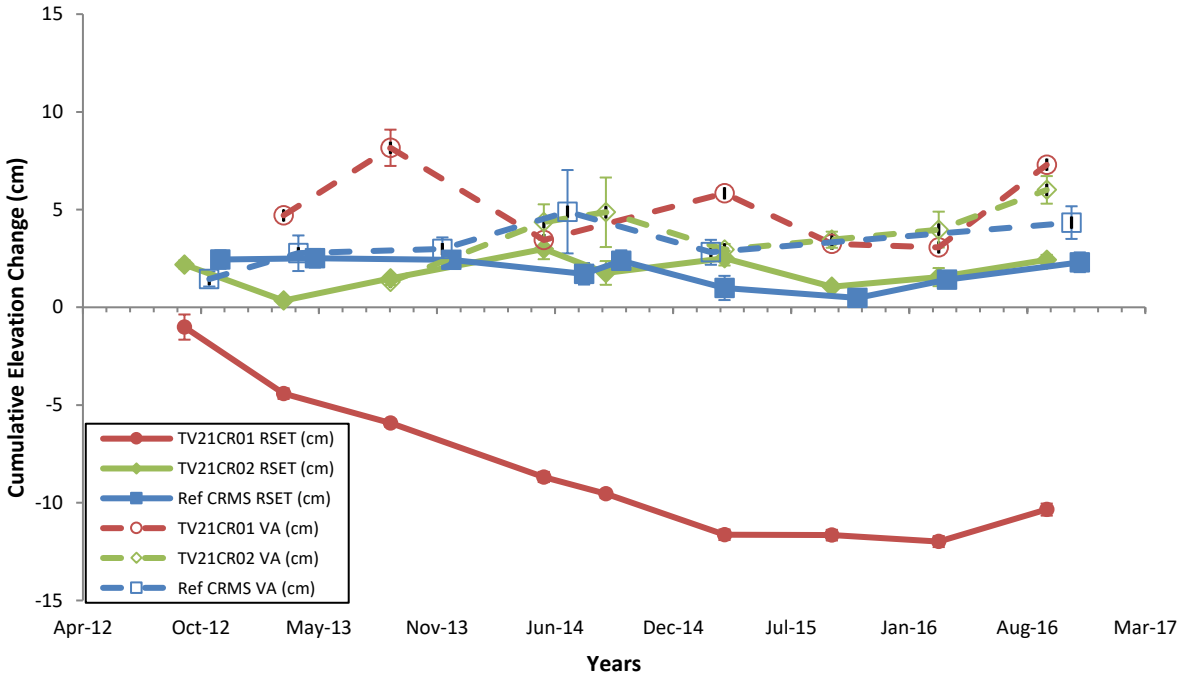

Figure 9. Cumulative elevation change calculated from surface elevation measurements collected at rod-surface elevation tables (RSET) and vertical accretion measurements collected from horizon markers (VA) collected at TV-21 project and reference sites (CRMS0522, 523, 524) over time. Mean ± SE.

ix. Borrow Area (Dissolved O_2)

Dissolved oxygen (DO) levels were monitored in the borrow area and a reference area, just outside of the borrow area, in July through September 2012 (Figure 10a). Data was not collected in 2011 due to an equipment malfunction. A non-parametric one way median analysis was run to compare the 2012 data from both areas. It was found that DO levels were significantly lower in the borrow area than the reference area, particularly during the beginning of the sampling period (x^2=10.54, p=0.0012). Slightly higher water temperatures were recorded during the beginning of the sampling period, when compared to mid-August through September which may have caused this effect. Hypoxic conditions <2 mg/L) did not occur in either area, though. The lowest DO levels occurred on July 28 in the borrow area and were 2.24 mg/L. The post-construction surveys completed in March 2012 showed significant infilling of the borrow area during the first year since construction.

The Louisiana Borrow Area Management and Monitoring (BAMM) Program conducted DO sampling in the TV-21 borrow area in 2013 as part of a larger study aimed at determining the impacts of borrow area design on the surrounding environment and determining how best to manage a borrow area for optimum usage with the least environmental impact (CB&I 2015). DO levels were monitored in June-October 2013 (Figure 10b). Hypoxic conditions were measured in the borrow area alone for one day in July, but only for one reading. During the July-August period, DO in the borrow area was generally about 2 mg/L lower than the reference area. However, hypoxic conditions were only measured in the borrow and reference areas briefly during a four day period in August, coinciding with a high variability in salinity. Unfortunately, the borrow area recorder data was lost from August 19 – September 20, limiting the ability to compare the two areas during a period when low DO could likely be observed in the Gulf of Mexico, though hypoxic conditions did not occur in the reference area during this time. Regardless, given the data collected, there was insufficient evidence to indicate that the dredging for the TV-21 project had an adverse effect on the existence of hypoxia in the area. The study concluded that the low DO levels observed were not likely to affect local aquatic organisms. Bathymetric data collected during the geophysical survey showed that the borrow area had infilled approximately 2,986,000 yards of the originally excavated volume of 3,836,209 yards. The average infilling of the borrow area was 7.0 ft with the range of infilling being between 0 to 12.7 ft.

Given the findings of the BAMM study and the significant infilling of the borrow area, it was decided to forego the 2016 DO monitoring.

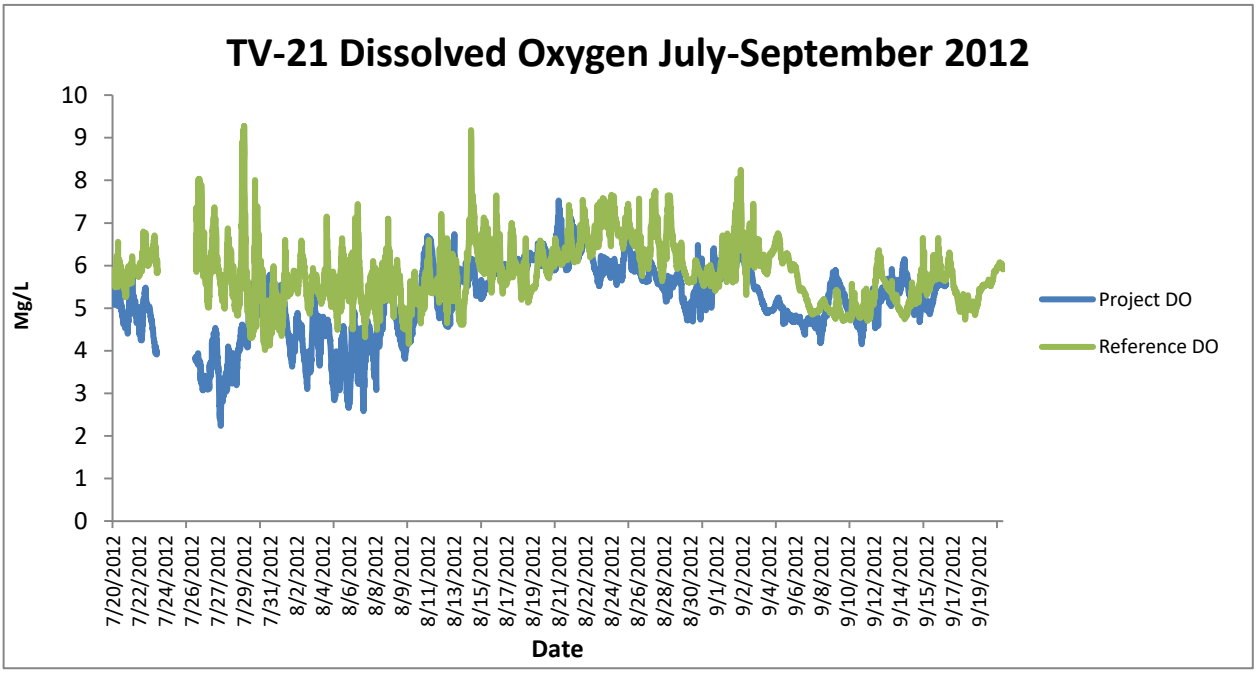

Figure 10a. Dissolved oxygen levels (mg/L) in the TV-21 borrow and reference areas from July-September 2012.

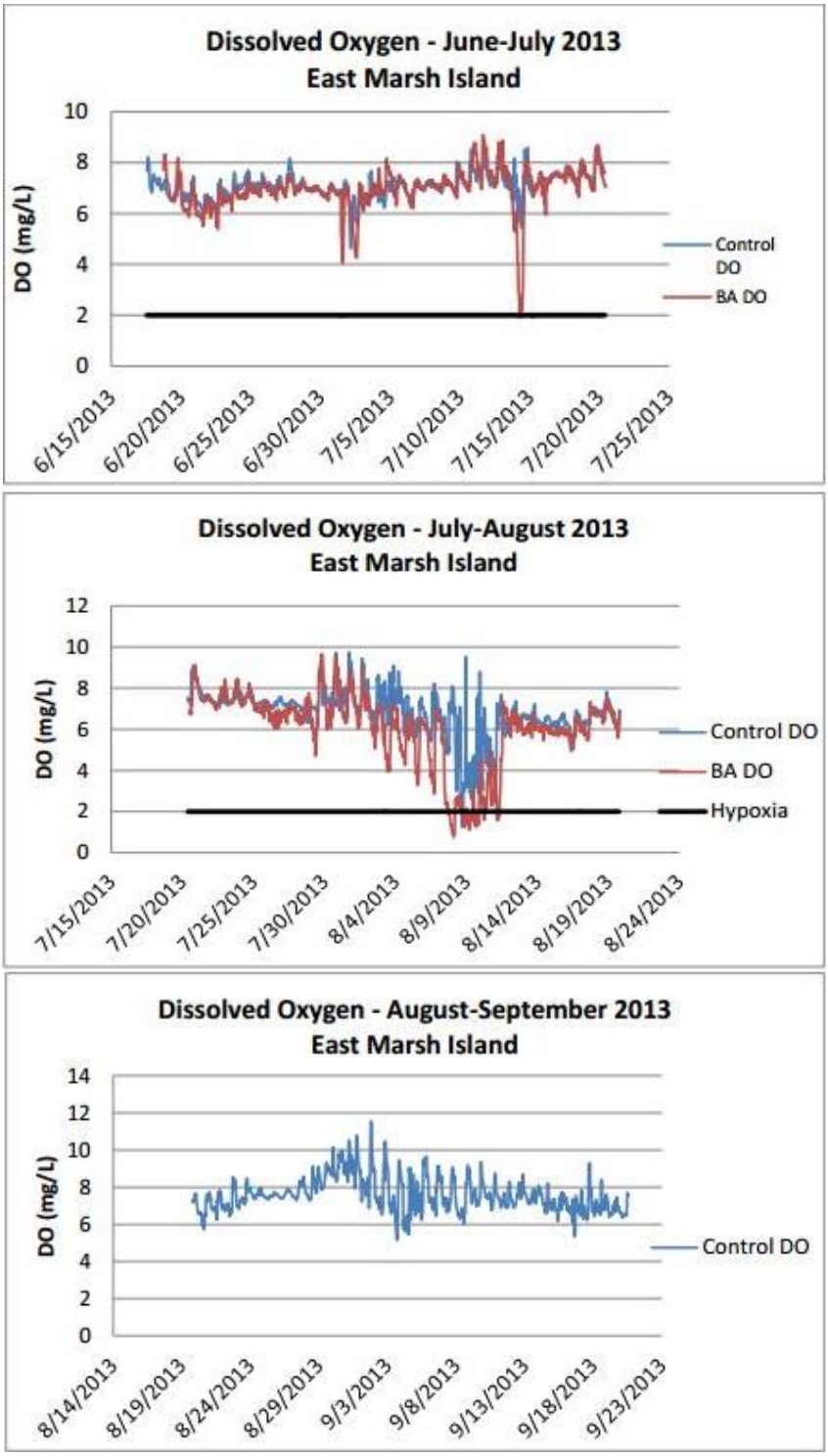

Figure 10b. Dissolved oxygen levels (mg/L) in the TV-21 borrow and reference areas measured during the BAMM study from June-September 2013.

V. Conclusions

a. Project Effectiveness

The project has met the objectives of creating 362 acres of emergent marsh and creating/nourishing 797 acres of brackish marsh based on analysis of 2012 photography. Future analyses will allow us to determine if the project is meeting the objective of reducing the marsh loss rate by 50%.

Salinity levels in the project area remained within the targeted intermediate to brackish range in both surface and interstitial water readings. Water levels in the project area did not differ from reference area water levels, but the containment area had a lower percent time flooded than the nourishment and reference area due to a higher marsh elevation, though this elevation has settled over time, as evidenced by surface elevation change surveys. The fill material within the containment area continually settled for six years following construction, but has now started to gain elevation. The nourishment area is gaining elevation at a rate equal to the surrounding marshes.

Vegetation in the project area is thriving since recovering from nutria herbivory in 2012, and is reflective of the surrounding natural marshes, particularly in the nourishment area. Soil surveys in 2016 showed percent organic matter is starting to increase over the initial surveys after construction, while bulk density is starting to decrease, reflecting the increased vegetation production in the project area. A drop in soil pH values in the project area also indicated this. Vegetation was successfully established through an aerial seeding trial and could show promise as a revegetation technique for future projects.

Submerged aquatic vegetation was not found on the post-construction surveys. This doesn't necessarily mean the project has had a detrimental effect on SAV abundance, however, since the surrounding TV-14 project has had a low occurrence of SAV as well on recent surveys.

Dissolved oxygen level monitoring in the East Cote Blanche borrow area during 2012 and during the BAMM study in 2013 did not show that the dredging for the project had an adverse impact on DO levels in the area. Surveys also showed that by 2013 significant filling of the borrow area has taken place since construction. The most recent survey in 2017 showed continued infilling within the borrow area to an average sediment elevation of -11ft (an accumulation of 986,739 CY since 2011)

b. Recommended Improvements

An additional topographic survey of the marsh creation and nourished areas is included in the project O&M plan. Funding will determine when this task will take place and dictate a slightly reduced scope of work compared to prior surveys.

c. Lessons Learned

Without protection, earthen dikes and fill material cannot withstand the effects of direct wave action from the bay or gulf long term. Well established vegetation can reduce the wave energy but has shown to succumb over time to high energy weather events. Armoring has been the resolution chosen for this particular project in those areas where the most direct impact has occurred and rapid erosion has taken place.

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Appendix A

Photographs

Photo No. 1, MC Cell No. 1 - Articulated Concrete Mat (2015 Maintenance Event)

Photo No. 2, MC Cell No.1 & Nourished Area No. 4, Breach Repair (NE Corner of Island at East End of E-W Pipeline Canal (2015 Maintenance Event)

Photo No. 3, MC Cell No. 1, North South Canal Looking North

Photo No. 4, MC Cell No. 2, Plug at End of North-South Canal (Looking North)

Photo No. 5, Nourished Area No. 4, Plug
(TV-14 Project- End of East West Canal Looking North)

Photo No. 6, MC Cell No. 1, Plug Tie-In
(TV-14 Project- End of East West Canal - Looking Southeast)

Appendix B

Three Year Budget Projection

EAST MARSH ISLAND MARSH CREATION/ TV-21 / PPL 14

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

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Pat Landry	*Jody White*	*NRCS*	*Jody White*

	2017/2018(-6)	2018/2019 (-7)	2019/2020 (-8)
Maintenance Inspection	$ 7,269.00	$ 7,487.00	$ 7,712.00
Structure Operation			
State Administration	$ 5,000.00		$ 5,000.00
Federal Administration	$ 8,000.00		$ 8,000.00
Maintenance/Rehabilitation			

17/18 Description: Survey Borrow Area and Project Area

E&D	$ 7,766.00
Construction	$ 90,000.00
Construction Oversight	
Sub Total - Maint. And Rehab.	$ 97,766.00

18/19 Description:

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

19/20 Description: Survey Project Area

E&D	$ 6,176.00
Construction	$ 70,000.00
Construction Oversight	
Sub Total - Maint. And Rehab.	$ 76,176.00

	2017/2018(-6)	2018/2019 (-7)	2019/2020 (-8)
Total O&M Budgets	**$ 118,035.00**	**$ 7,487.00**	**$ 96,888.00**

O &M Budget (3 yr Total)	**$ 222,410.00**
Unexpended O & M Budget	**$ 1,728,990.00**
Remaining O & M Budget (Projected)	**$ 1,506,580.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 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	1	$7,766.00	**$7,766.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

STATE Admin.	LUMP	1	$5,000.00	$5,000.00
FEDERAL SPONSOR Admin.	LUMP	1	$8,000.00	$8,000.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$13,000.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:	Survey Borrow Area and Project Area				
	Secondary Monument	EACH	0	$0.00	$0.00
	Staff Gauge / Recorders	EACH	0	$0.00	$0.00
	Marsh Creation Topo & Borrow Bathymetry	LUMP	1	$90,000.00	$90,000.00
	TBM Installation	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL SURVEY COSTS:	**$90,000.00**

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: **$118,035.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 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**
Operations Contract	LUMP	0	$0.00	**$0.00**
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: **$7,487.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 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	1	$6,176.00	**$6,176.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

STATE Admin.	LUMP	1	$5,000.00	$5,000.00
FEDERAL SPONSOR Admin.	LUMP	1	$8,000.00	$8,000.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$13,000.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:	Survey project area				
	Secondary Monument	EACH	0	$0.00	$0.00
	Staff Gauge / Recorders	EACH	0	$0.00	$0.00
	Marsh Elevation / Topography	LUMP	1	$70,000.00	$70,000.00
	TBM Installation	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL SURVEY COSTS:	**$70,000.00**

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: **$96,888.00**

Appendix C

Field Inspection Form

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-21 East Marsh Island Marsh Creation

Date of Inspection: May 16, 2017 Time: Approximately 10:00am

Structure No. N/A

Inspector(s): Dion Broussard, and Jody White (CPRA)
Tyson Crouch and Steven Berger (LDWF),
Sharon Osowski (EPA), Dale Garber (NRCS), Scott Wandell (

Structure Description: Marsh Creation Cells, Nourishment Areas, Earthen Plug

Water Level:

Salinity Readings:

Type of Inspection: Annual

Weather Conditions: Sunny and Mild

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Earthen Plug (End of N-S Canal)	Good	No		4	Good Condition.
Nourised Areas (1-4)	Good	Yes		2	Only areas 3 & 4 were visited during the inspection. But survey info show all four areas are doing well. Nourished area No. 1 has slightly settled.
Vegetation	Good			1-3, 6	Vegetation is thriving in the project. WLF nutria program has been effective in controlling the nutria population.
Settlement Plates	Good				
Marsh Creation Cells (1 & 2)	Good			1-4	In good condition. Suvey info indicates average marsh elevation is at 1.33ft NAVD88 which is consistent with the projected settlement curve.
Containment Dikes	Good			1-4,6	The area armored in the 2015 maintenance event has settled some but is still providing protection. (The rock Plug on the E-W Canal at the N-S Canal has also settled some. Part of TV-14, removed and replaced as part of 2015 maintenance event.)

What are the conditions of the existing levees?	
Are there any noticeable breaches?	The articulated mats placed along the gulfward shoreline have settled.
Settlement of rock plugs and rock weirs?	The replaced rock plug has settled slightly in the center.
Position of stoplogs at the time of the inspection?	N/A
Are there any signs of vandalism?	N/A