**State of Louisiana**

**Coastal Protection and Restoration Authority of Louisiana (CPRA)**

**Office of Coastal Protection and Restoration**

# 2014 Operations, Maintenance, and Monitoring Report

For December 2014

## Sabine Refuge Marsh Creation Cycles - 1 and 3

State Project Number CS-28
Priority Project List 8

June 2014
Cameron Parish

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**Suggested Citation:**

Miller, M. 2014. *2014 Operations, Maintenance, and Monitoring Report for Sabine Refuge Marsh Creation (CS-28), Coastal Protection and Restoration Authority of Louisiana, Coastal Protection and Restoration, Lafayette, Louisiana. 25pp.*

2014 Operations, Maintenance, and Monitoring Report
For
Sabine Refuge Marsh Creation (CS-28)

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## Preface

The 2014 OM&M Report format combines the Operations and Maintenance annual project inspection information with the monitoring data and analyses for the project. This report includes monitoring data collected through December 2013. There is no operations and maintenance of Cycle 3 of the Sabine Marsh Creation Project.

The 2014 report is the 4th report in a series of OM&M reports on CS-28 Cycles. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2005, 2007, and 2011 Operations, Maintenance, and Monitoring Reports, on the CPRA web site (http://lacoast.gov/new/Projects/Info.aspx?num=CS-28-1 or CS28-2 or CS-28-3).

## I. Introduction

The project area is composed of 5,776 acres (2337.5 ha) of wetlands located in the Calcasieu-Sabine Basin in the Chenier Plain. The area is within the Sabine National Wildlife Refuge and roughly bounded by Starks North Canal to the north and east, Back Ridge Canal to the south, and existing marsh to the west (Figure 1). Hurricanes and canal building between 1956 and 1978 caused land loss in the area. Saltwater from the Calcasieu Ship Channel (CSC) is currently introduced from several sources including the GIWW through the Alkali Ditch, Rycade canal via Black Lake and although now controlled by structures limited salt water enters through the Hog Island Gully and West Cove Canals via Back Ridge Canal (Miller 1997). From 1968 to 1988 vegetation shifted from intermediate sawgrass dominated marsh including *Cladium jamaicense* (sawgrass), *Schoenoplectus californicus* (giant bulrush), and *Phragmites australis* (Roseau cane), with some fresh marsh to more brackish species including *Spartina patens* (saltmeadow cordgrass), *Schoenoplectus americanus* (bulrush), and *Schoenoplectus robustus* (saltmarsh bulrush) (Chabreck and Linscombe 1968, 1978, 1988). Most of the project is shallow open water with brackish marsh on the surrounding edges. The Chenier Plain area has lost 347.0 $mi^2$ (898.8 $km^{2)}$ of land between 1956 and 2006. The 1956 to 2006 annual land loss rates for the Chenier Plain are -6.9 $mi^{2/}$yr (-17.9 $km^2$/yr) (Barris, 2008).

The Sabine Refuge Marsh Creation Project (CS-28) is designed to create approximately 1,120 acres (450 ha) of emergent vegetated marsh and to nourish and protect existing broken marsh via five cycles. Material is dredged from the Calcasieu Ship Channel by the Corps of Engineers as part of their annual maintenance dredging effort. Cycle 1 was constructed in January 2001 with approximately 1,000,000 $yd^3$ of sediment pumped into a 200 acre containment area to an elevation of 4.0 to 4.4 ft MLG (2.7 to 3.1 ft NAVD88 (Geoid 99)). Cycle 3 was constructed in May 2007 when 828,767 $yd^3$ of sediment was pumped into a 230 acre containment area to an elevation of 2.6 to 4.2 MLG (1.3 to 2.9 ft NAVD88 (Geoid99)). Cycle 2 was constructed in May 2010 when dredged material was pumped into a 230 acre containment area via a permanent

pipeline that was constructed for Cycle 2 and future cycles. The amount of material and as-built elevation for Cycle 2 is unavailable. The Cycle 2 marsh creation was constructed as a State-only project and not a CWPPRA project. Cycles 4 and 5 are going to be filled via the permanent pipeline during the Corps of Engineer's 2014 maintenance dredging effort.

Each of the cycles had a delta formation component where the levee facing the interior of the project area was breached, gapped or built to a lower elevation to allow extra material to flow into the open water to create additional shallow water habitat. Cycle 1 created a few extra acres, Cycle 3 didn't create any, and Cycle 2 created at least 100 additional acres.

Cycle 1 had 20-foot wide by 5 foot deep channels dug during construction to serve as hydrologic and fish access channels. The material dug from the channel created a small berm that prevented sheet flow across the area. Small gaps were created in the interior levees every 500 ft. In those areas, the backhoe was driven across the surface while material was still soft to create depressions that served as channels that aligned with the gaps in the levee.

Cycle 1 had 36,000 *Spartina alterniflora* plantings planted around the perimeter and along the hydrologic and fish access channels. The interior of the newly created marsh re-vegetated quickly on its own so plantings were not utilized after Cycle 1.

Cycle 2 was converted to a State Only project after the permanent pipeline construction. All but the permanent pipeline were removed from cycle 2 therefor there is no biological monitoring data available for Cycle 2. Cycle 1 had project specific vegetation monitoring stations that were replaced with a CRMS station in 2009. Cycle 3 has project specific vegetation and elevation monitoring. Vegetation, elevation, and potentially land change via aerial photography will be monitored in Cycles 4 and 5.

This report will include all available information on Cycles 1, 2 and 3.

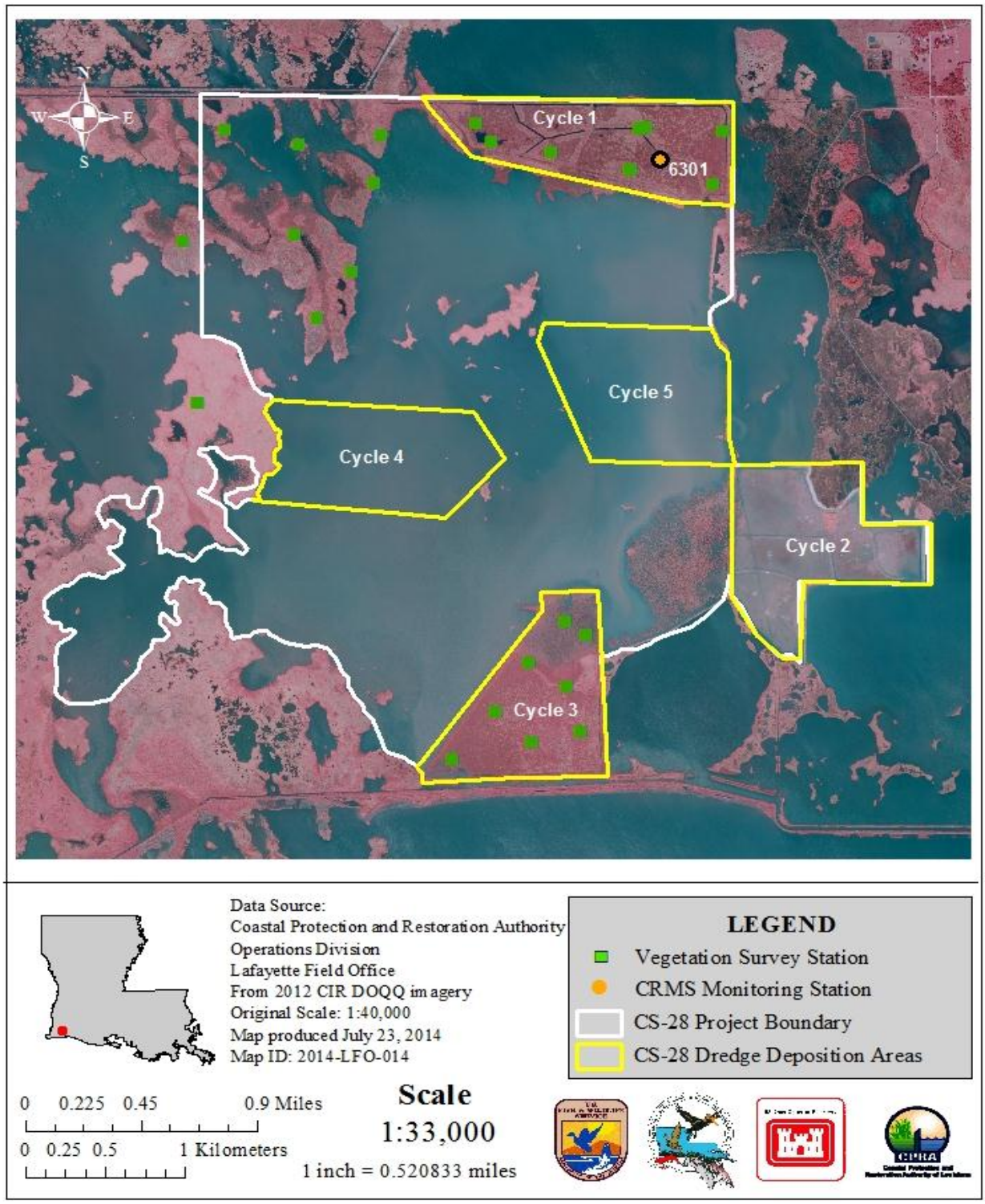


**Figure 1:** Sabine Refuge Marsh Creation (CS-28) project area boundary, deposition area boundaries, vegetation monitoring stations, and CRMS site.

## II. Maintenance Activity

Most of the dredged material cells have no operations or maintenance, but Cycle 1 O&M consisted of degradation of the southern retention dikes 1-2 years post construction.

## III. Operation Activity

### a. Operation Plan

There are no water control structures associated with this project; therefore no Structural Operation Plan is required.

### b. Actual Operations

There are no water control structures associated with this project; therefore no required structural operations.

## IV. Monitoring Activity

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the CWPPRA Coastwide Reference Monitoring System-Wetlands (CRMS-Wetlands, updates were made to the CS-28 Monitoring Plan to merge it with CRMS-Wetlands and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of CWPPRA. CRMS06301 was constructed in the Cycle 1 dredge deposition area. No CRMS-Wetlands sites are located within the Cycle 3 project area.

### a. Monitoring Goals

The objectives of the Sabine Refuge Marsh Creation Project are:

1. To create new vegetated marsh.

2. Enhance and protect existing surrounding marsh vegetation.

The following goals will contribute to the evaluation of the above objectives:

1. Place dredge spoil slurry to a maximum height of 4.5 ft (1.4 m) MLG (3.2 ft Geoid 99 NAVD88) to settle to a height of 2.5 ft (0.8 m) MLG, (1.2 ft Geoid 99 NAVD 88) after five years, for each of five dredging cycles.

2. Create 125 acres (50 ha) of vegetated wetlands in the first dredge placement cycle and 230 acres (93 ha) in each of Cycles 2 through 5.

3. Reduce the loss of existing surrounding marshes within the project area.

### b. Monitoring Elements

**Aerial Photography:**
Near-vertical color-infrared aerial photography (1:24,000 scale) was used to measure vegetated and non-vegetated areas for the project and reference areas. The photography was collected on December 20, 2009 after construction of Cycle 3 (Figure 3). The original photography was checked for flight accuracy, color correctness, and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and georectified by USGS/NWRC personnel according to standard operating procedures (Steyer et al. 1995, revised 2000). Additional photography will be collected in 2018. In order to estimate land/water coverage after 2009, ArcGIS was used to calculate land coverage within Cycle 3 using 2012 color-infrared aerial photography. Google-Earth imagery was used to display the land/water changes within Cycle 3 from 2009 to 2013 (Figure 5a and 5b).

**Emergent Vegetation:**
In Cycle 3, eight vegetation stations were established in 2008 and were monitored in 2010 and 2012. Two 2 $m^2$ plots were sampled at each of the stations. Percent cover, height of dominant species, and species richness were quantified. Ten reference stations were established in the pre-existing, reference marshes in the northwest corner of the project area (Figure 1). Cycle 1 is monitored annually with ten CRMS6301 vegetation stations. Cycle 3 will be monitored in 2014, 2016, and 2018. Cycle 2 will not be monitored although visual inspections will be made during each Cycle 3, 4 and 5 field trip.

**Elevation Survey:**
Available elevation data for Cycle 1 includes the contractors report, the as built survey, and elevation change from the Rod Surface Elevation Table (RSET) at the CRMS6301 site. Cycle 3 contains elevations from the contractors report and a monitoring survey conducted in August 2013. No as-built elevation is available for Cycle 2 and no surveys were conducted after construction.

### c. Preliminary Monitoring Results and Discussion

**Aerial Photography:**
Land: Water aerial photography was captured and analyzed in 2002 and 2009 (Figures 2 and 3). The Cycle 1 fill area had 171 acres of vegetated land eight years after construction in 2009 (86% of the 200 acre cell). The remaining 29 acres consisted of previously existing land, trenasses, and 4 acres of unvegetated dredged material (Figure 3). It is clear from Google Earth Imagery that the Cycle 1 area was scarcely vegetated in September 2003 (2.75 years after construction), and that vegetation had emerged and began to spread by September 2004 (3.75 years after construction) (Figure 4a and 4b).
In the 1.75 years between construction and assessment, 135 acres (58%) of the Cycle 3 area had converted from dredged material to land (Figure 3). Of the remainder, less than 10 acres were

pre-existing land and roughly 90 acres were too deep for rapid colonization by emergent vegetation.

No portion of the Cycle 3 area was planted. The May, 2013 Google Earth Image shows that most of the low lying area that was not quickly vegetated became vegetated between December 2010 (3.6 years after construction) and May 2013 (6.0 years after construction) (Figure 5a and 5b). Interestingly, the vegetation in the northern portion of the cell that had not originally vegetated seems to have become vegetated at the same time as the rapid expansion of vegetation onto the mudflats. Thes mud flats were created in the expansive overflow area of the Cycle 2 cell which was constructed in May, 2010 (Figure 5a and 5b).

It was clear from the Google Earth Imagery that three years after construction, Cycle 2 had not begun to vegetate (Figure 5a and 5b). There are a few individual plants scattered across the cell but no significant coverage up to May 2013. The large mudflat created with dredge overflow vegetated within two years. It has been suggested that the cell may have been pumped too high for emergent wetland vegetation to take hold or that there is no hydrologic flow due to the dikes remaining ungapped. We do not have specific data but we do know that the area remained unvegetated in September, 2014 (4.3 years after construction). We expect the area to eventually vegetate.

The project is achieving its goals of creating land and appears to be preventing land loss in adjacent marshes.

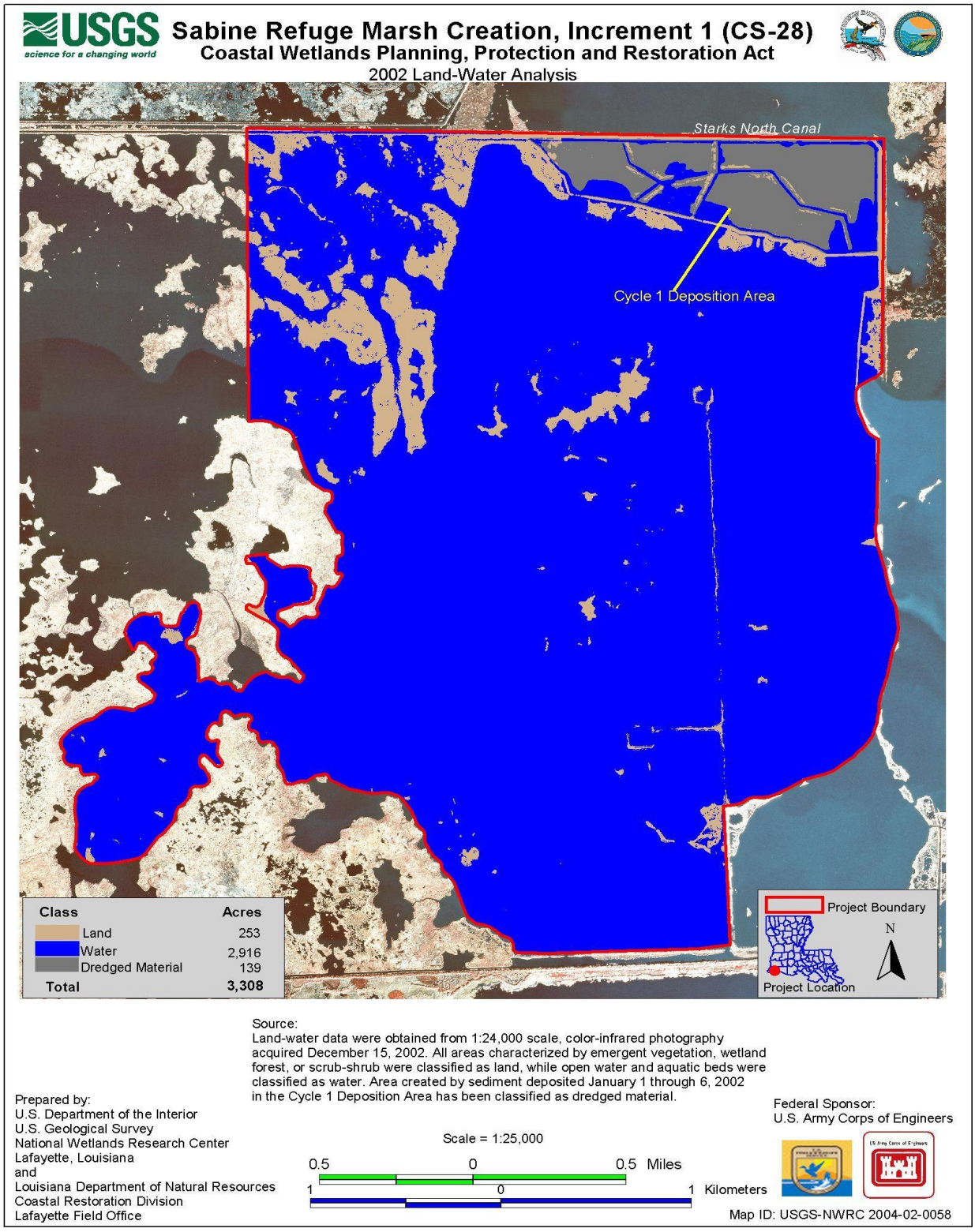


**Figure 2.** Land:Water analysis from photography obtained December 15, 2002 with project boundaries and land, water, and dredge material acreages.

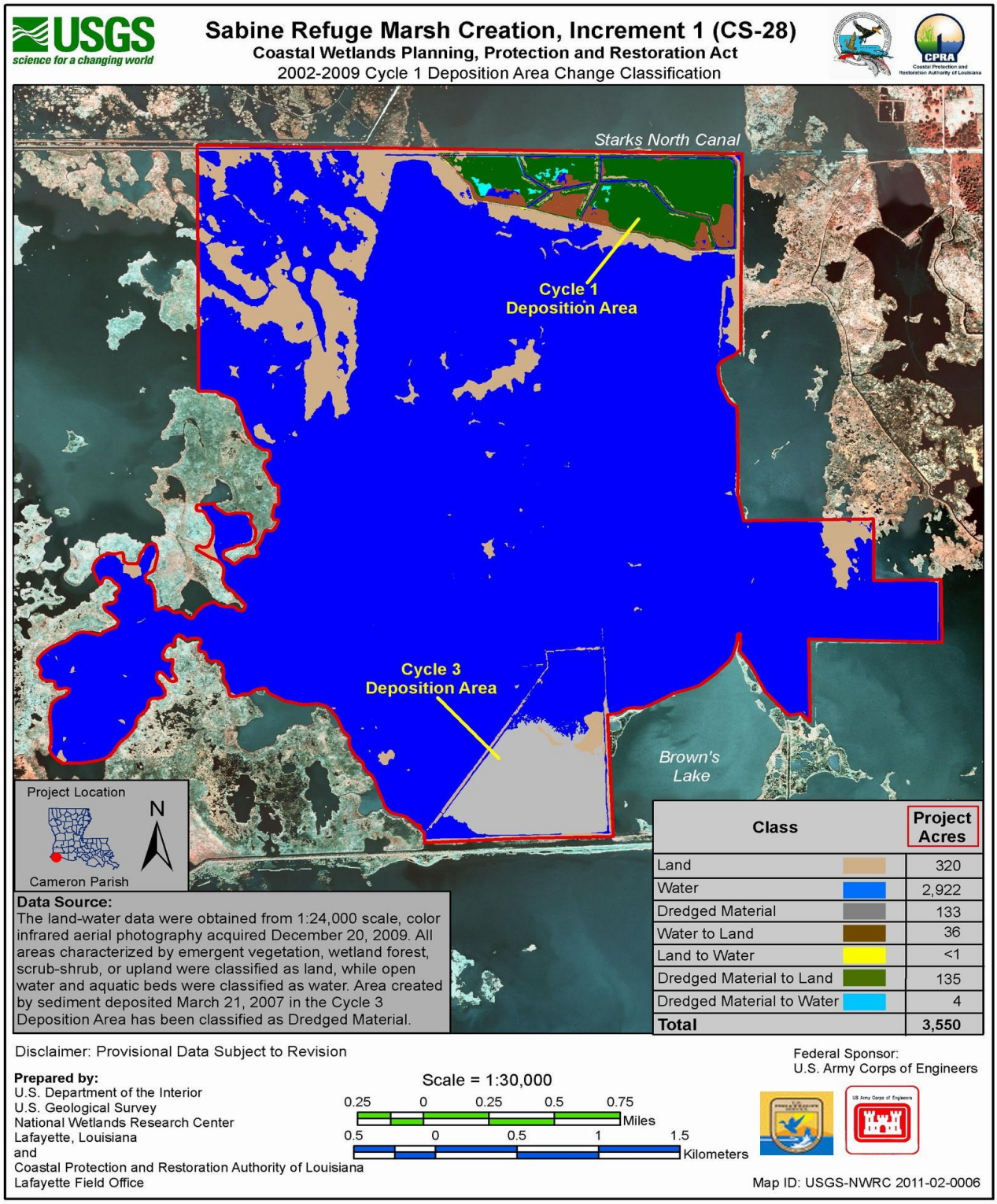


**Figure 3.** Land:Water change from photography obtained in December 2002 and 2009.


**Figure 4a and 4b.** Visual vegetation change in cycle 1 as seen from Google-Earth imagery in September 2003 and September 2004.

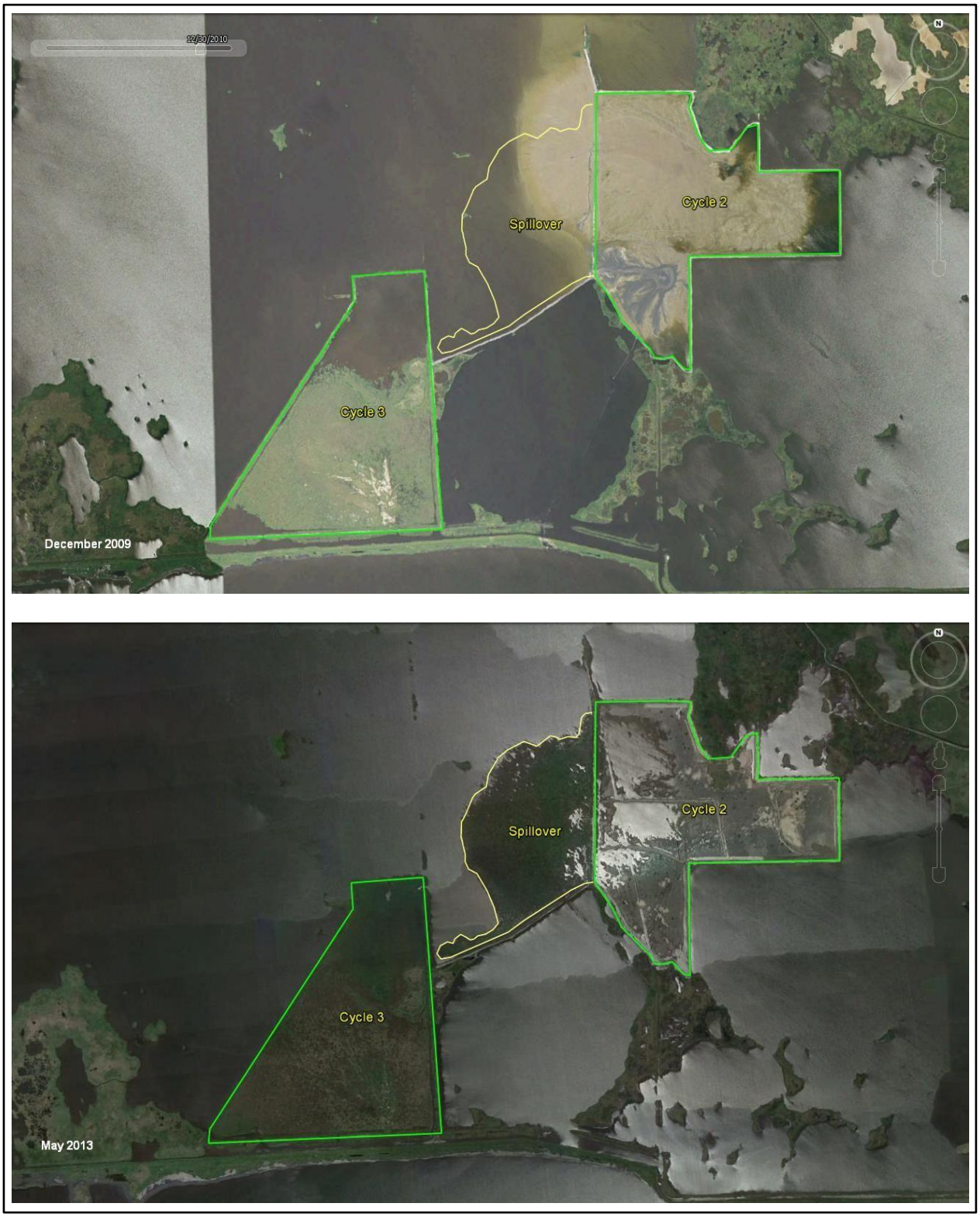


**Figure 5a and 5b.** Visual vegetation change in cycle 3 and marsh creation from spillover in Cycle 2 as seen from Google-Earth imagery in December 2009 and May 2013.

**Emergent Vegetation:**

Vegetation stations were established in Cycle 1 post construction in 2002 while the cell was still a mudflat (Figure 6). *Spartina alterniflora* was planted along the edges of Cycle 1 in 2002. By 2004, the Cycle 1 area was dominated by *Spartina alterniflora* over five feet tall (Figure 7). The dredged material probably contained mineral rich clays that *S. alterniflora* was responding to. Hurricane Rita impacted Cycle 1 vegetation significantly (Figure 8). The immediate hurricane impact was much stronger in the project area than in the reference area (Figures 8-9). Both the Cycle 1 area and the reference area had recovered from the Hurricane a year later (Figures 10a and 10b).

Cycle 3 was constructed in 2007 and had begun to vegetate on the southern end but still had open water areas on the northern end (Figure 11) until vegetation crept northward in 2012 (5 years post construction),(Figure 12). Prior to the first measurements in 2008 natural re-vegetation can be seen growing within the Cycle 3 project area (Figure 13).

The Cycle 1 deposition area recovered quickly from Hurricane Rita in total cover (Figure 14), height of dominant species (Figure 15), and continued to slowly increase in species richness (Figure 16).

The species assemblage in Cycle 3 was slightly different than in Cycle 1 in the first couple of years. Cycle 1 was essentially a monoculture of *S. alterniflora* while Cycle 3 had some stands of *Salicornia depressa* until 2010. In 2012 the S*alicornia depressa* was replaced with *Distichlis spicata* (Figure 17). We can assume the difference was due to the plantings (which were not installed in Cycle 3). The assumption that the Cycle 3 cell would vegetate from seed appears to have been correct. Although not significant, Cycle 3 had slightly more total cover than the Cycle 1 and the reference area in 2012 (Figure 14). It will take a long time for either area to be as diverse as the reference area although Cycle 1 did show a presence of *Spartina patens* in 2013 (12 years after construction) and the S*alicornia depressa* was replaced by *Distichlis spicata* in 2012 within Cycle 3 (Figure 17). Currently Cycle 3 has the least diverse plant community with only 2 species while the Cycle 1 and reference area have 8 and 9 species respectively. It will be interesting to see whether the natural community that develops in Cycle 3 is similar to Cycle 1 and whether Cycle 1 vegetation will eventually mirror the vegetative community present in the existing reference marsh.

**Figure 6.** Photograph of vegetation station (CS28-205) in the Cycle 1 deposition area at time of establishment (September, 2002; 1.75 years after construction). The plants in the background are the succulent *Salicornia bigelovii*.


**Figure 7.** Photograph of vegetation station (CS28-205) in the Cycle 1 deposition area 3.7 years after construction (August, 2004).

**Figure 8.** Photograph of vegetation station (CS28-200) in the Cycle 1 deposition area six weeks after Hurricane Rita and 4.8 years after construction (October, 2005).

**Figure 9.** Photograph of vegetation station (CS28-150) in the reference area six weeks after Hurricane Rita (October, 2005).

**Figure 10a and 10b.** Photographs of vegetation stations in October 2006 1.1 years after Hurricane Rita. Top: Cycle 1 station (CS28-205) Bottom: Reference station (CS28-150)

**Figure 11.** Photograph of vegetation station (CS28-307) in the Cycle 3 deposition area 3.25 years after construction (August, 2010).


**Figure 12**. Photograph of vegetation station (CS28-307) in the Cycle 3 deposition area 5.3 years after construction (September, 2012).

**Figure 13**. Cycle 3 as seen from the air in October 2008, 1.4 years after construction.

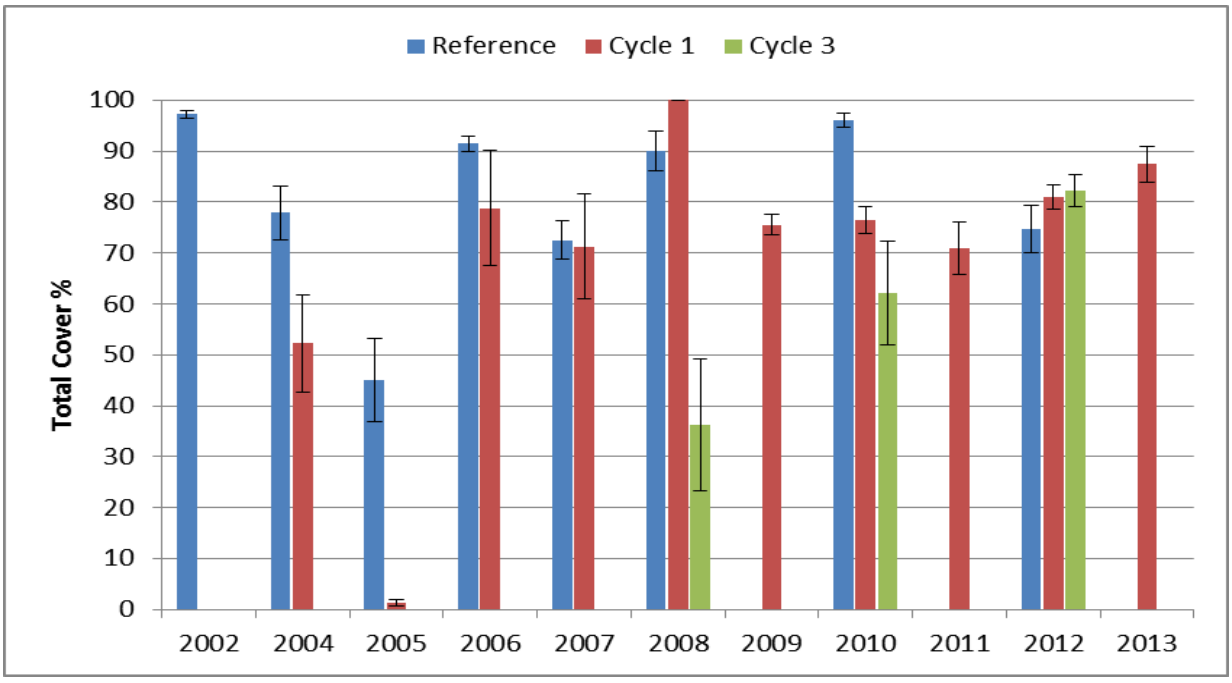


**Figure 14.** Total percent cover of emergent vegetation in the CS-28 project cycles and reference area. Mean ± SE. Note that beginning in 2009, Cycle 1 data is from CRMS6301.

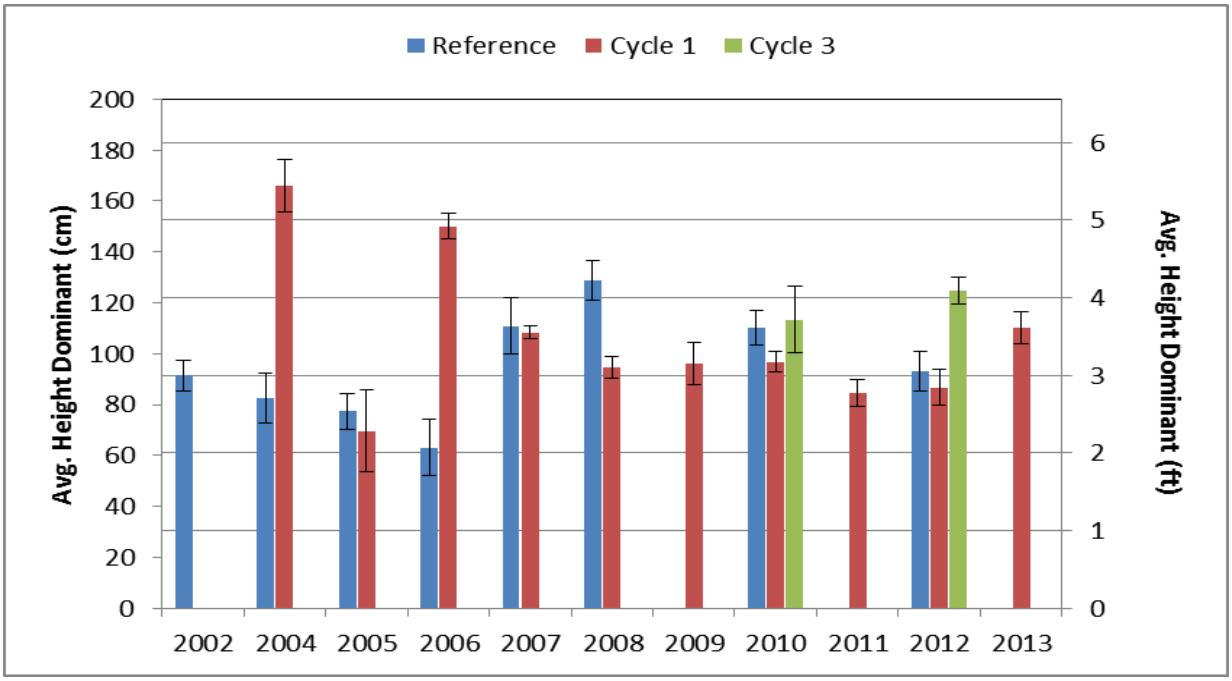


**Figure 15.** Average height of the dominant species of emergent vegetation in the CS-28 project cycles and reference area. Mean ± SE. Note that beginning in 2009, Cycle 1 data is from CRMS6301.

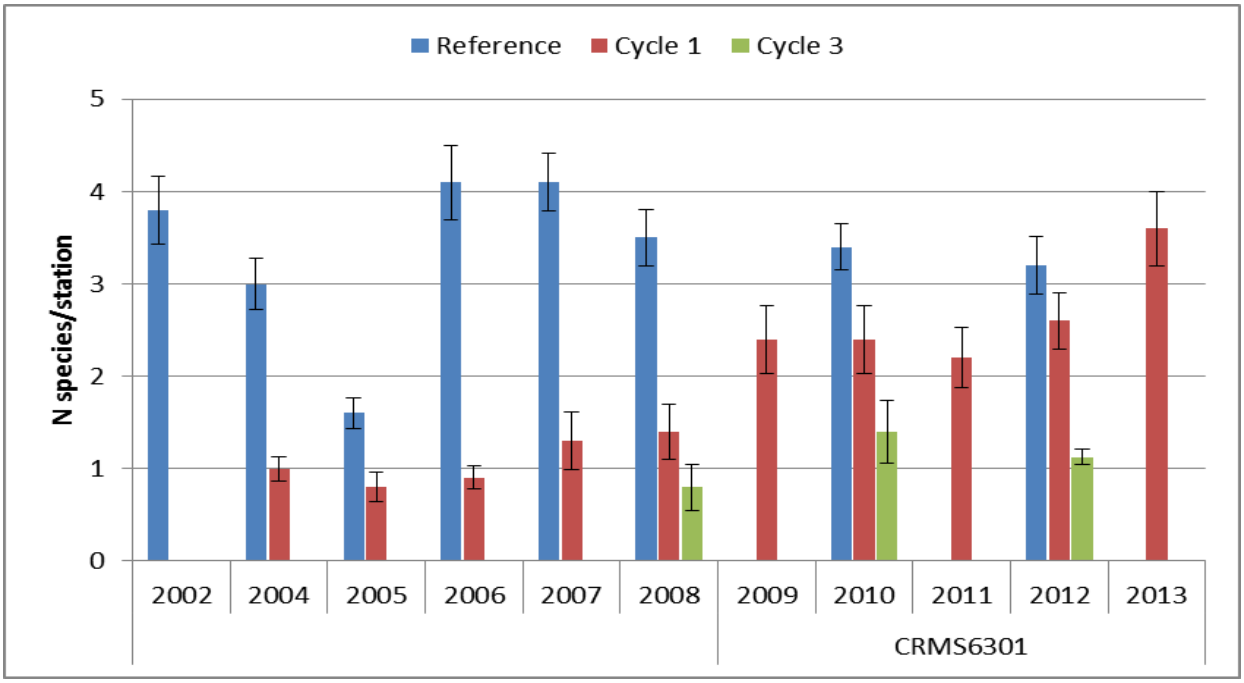


**Figure 16.** Species richness (n species per station) in the CS-28 project cycles and reference area. Mean ± SE. Note that beginning in 2009, Cycle 1 data is from CRMS6301.

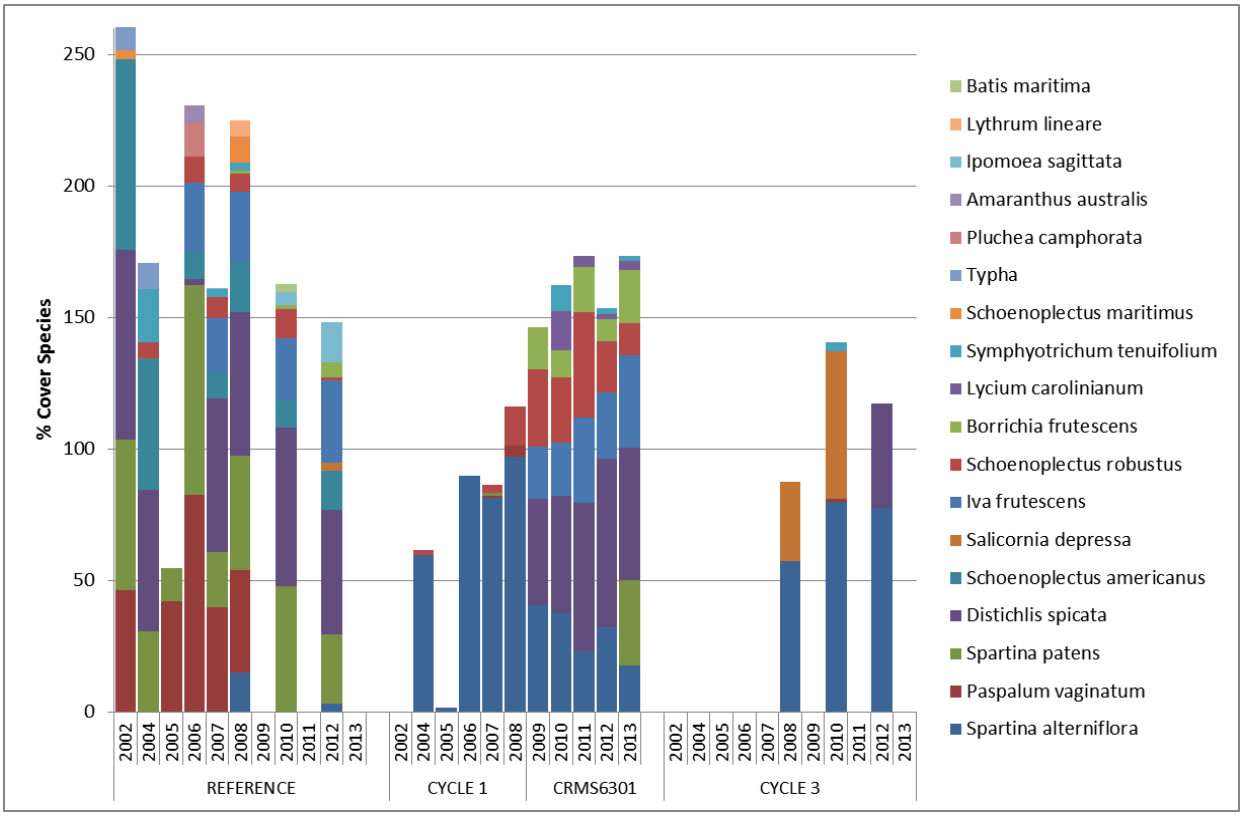


**Figure 17.** Cover of individual species in the CS-28 project cycles and reference area.

**Elevation:**

The goal for each of the cycles was a settled marsh elevation of 2.5 ft MLG (1.2 ft NAVD88 (Geoid 99)) after 5 years. For Cycle 1, CPRA has access to as-built surveys and the survey conducted on CRMS6301 when it was constructed. For Cycle 2, CPRA has the project completion report from the dredge contractor that has rough elevation estimates and a survey conducted in 2013 at year 6. No survey data is available for Cycle 2.

Cycle 1 was pumped to between 4.0 and 4.4 ft MLG (2.7 and 3.1 ft NAVD 88(Geoid 99)) and settled to 2.66 ft MLG (1.36 ft NAVD 88 (Geoid99)) by year 8 according to the CRMS survey. The CRMS survey was in NAVD88 (Geoid 99) so in order to convert, we utilized the measured difference between the two datum's at Calcasieu Locks (MLG = NAVD88 + 1.3'). The elevation change data from CRMS6301 indicates that the area is gaining elevation at +0.26 cm/yr. Cycle 1 settled to 0.16 feet (4.8 cm) above its 2.5 foot MLG (76.2 cm) (1.2 feet NAVD88 (Geoid99)) target.

Cycle 3 was pumped to between 2.6 and 4.2 ft MLG (1.3 and 2.9 ft NAVD 88(Geoid 99)) and was measured to be between 1.7 and 2.5 ft MLG (0.4 and 1.3 ft NAVD 88(Geoid 99)) in the 2013 survey at year 6. The Cycle 3 area is below the target elevation in the northern 3 of 9 transects surveyed in 2013 (Figures 18 and 19).

The 2013 survey extended into the existing marsh west of Cycle 3 and into the Cycle 2 mudflat located east of Cycle 3. The Cycle 2 overflow created 118 acres which are 1.8 ft MLG (0.5 ft NAVD 88(Geoid 99) and the pre-existing marsh is 2.5 ft MLG (1.2 ft NAVD 88(Geoid 99)), (Figures 19 and 20).

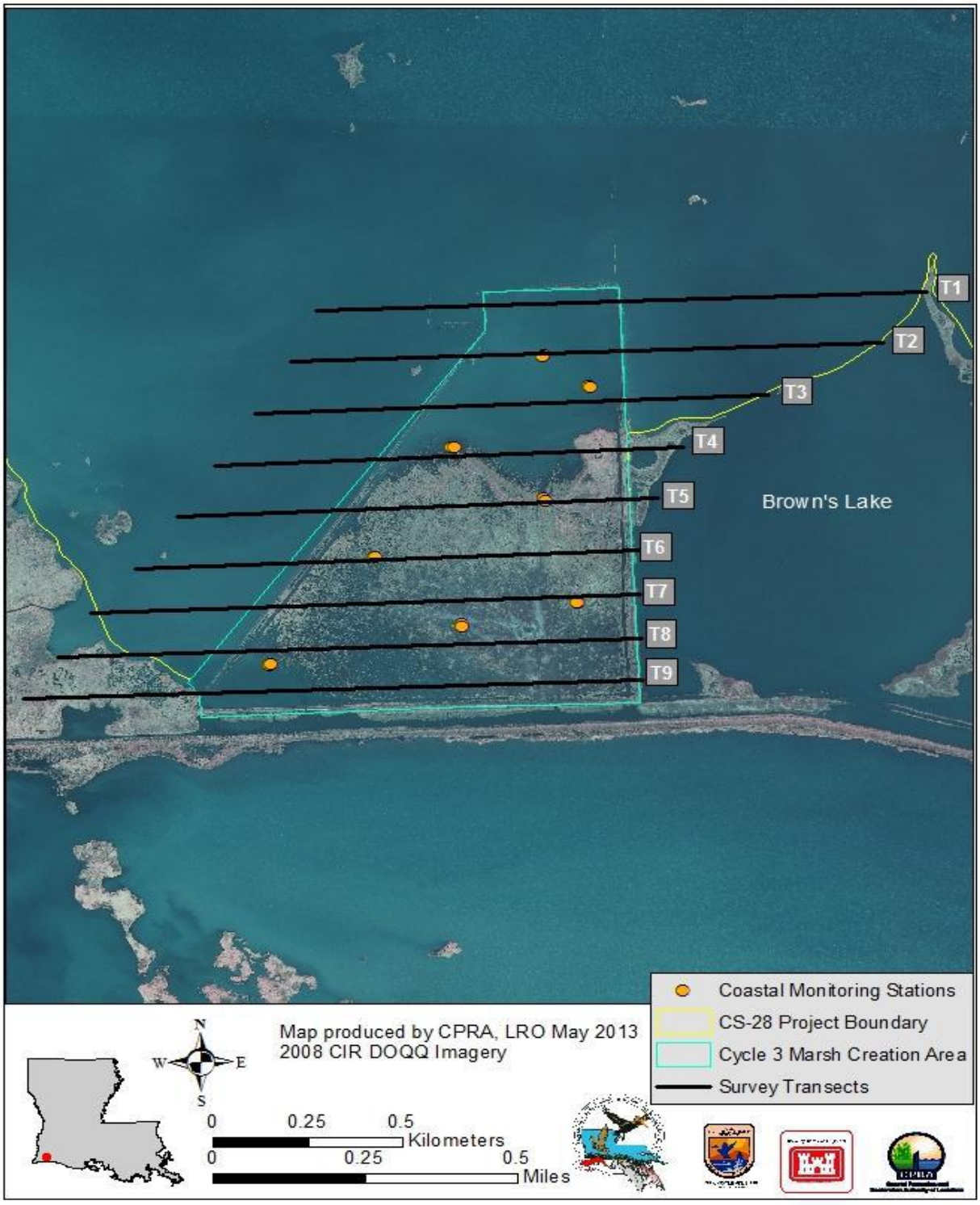


**Figure 18.** Survey transects, vegetation monitoring stations and project area boundary of the Cycle 3 deposition area.

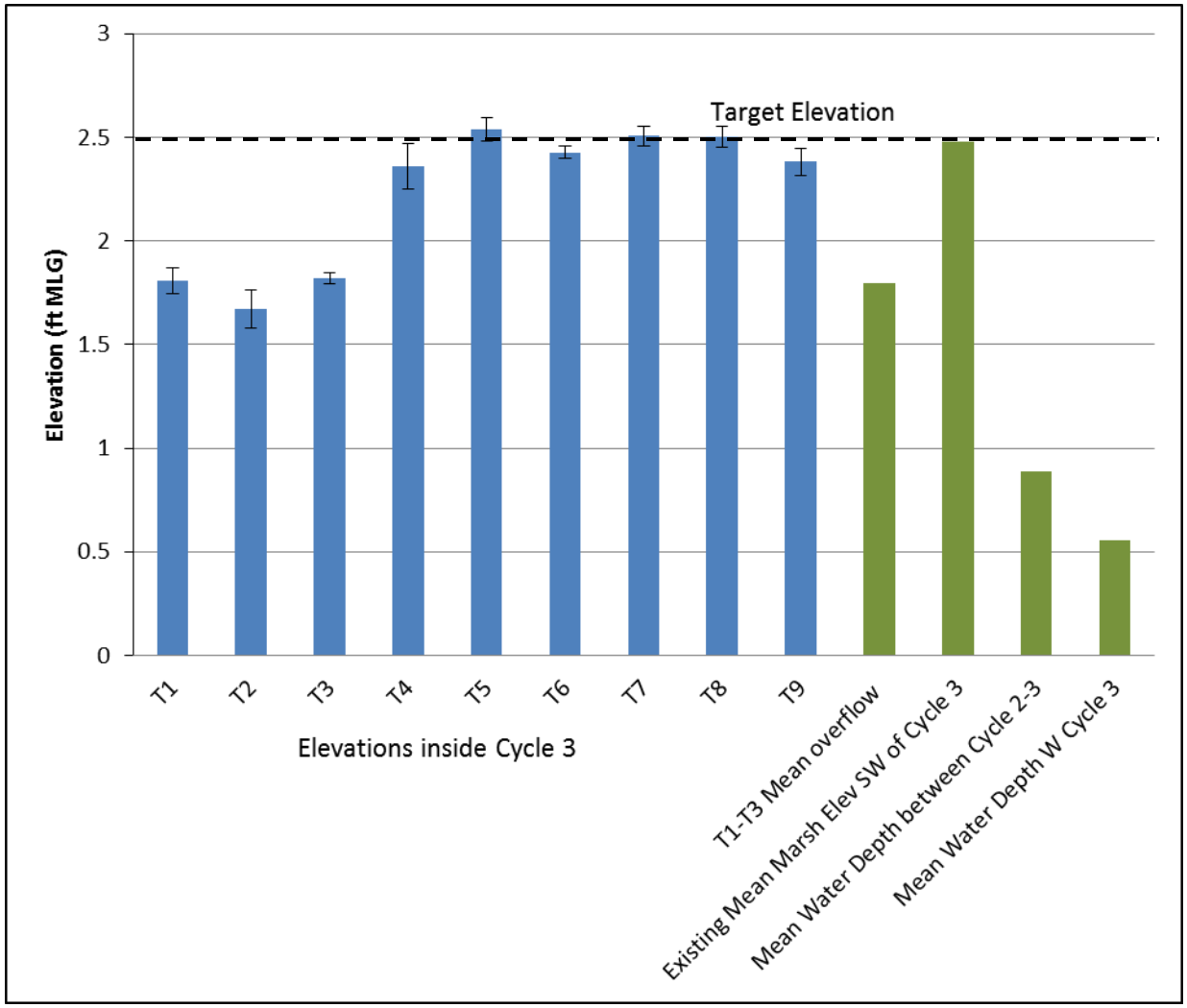


**Figure 19**. Mean marsh elevations of the nine survey transects, overflow area, existing marsh and water depth within and around the Cycle 3 containment area. Elevations were collected in Geoid 12A and converted to MLG.

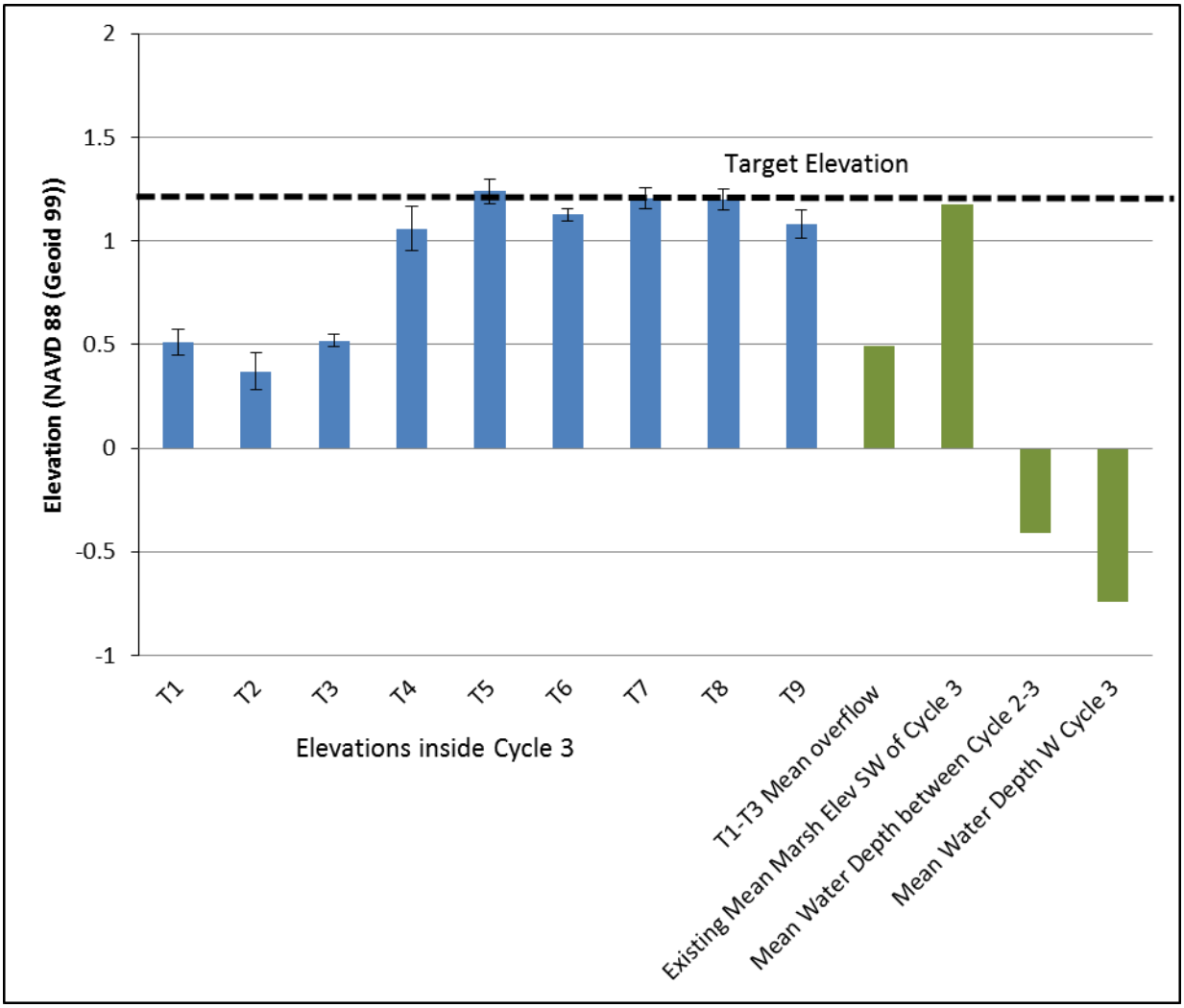


**Figure 20.** Mean marsh elevations of the nine survey transects, overflow area, existing marsh and water depth within and around the Cycle 3 containment area. Elevations were collected in Geoid 12A and converted to Geoid 99.

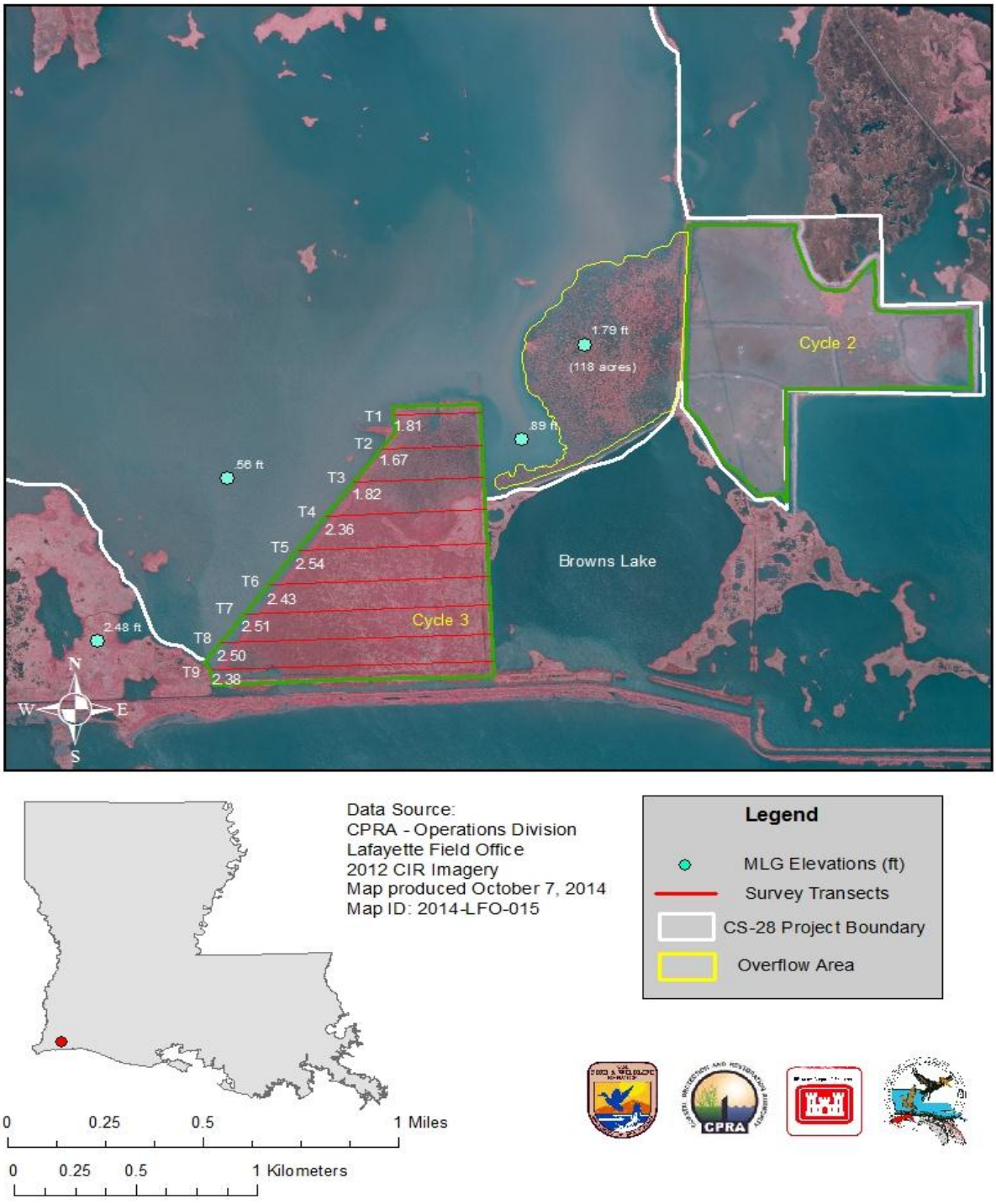


**Figure 20.** Google map depicting transects, spillover, water bottom and mean marsh elevations (ft MLG) within and around the Cycle 3 containment area.

# V. Conclusions

## a. Project Effectiveness

The major objective of the Sabine Refuge Marsh Creation Project is to create new vegetated marsh and to enhance and protect existing surrounding marsh vegetation. To date 365 acres have been created in Cycles 1 and 3 and up to 230 acres have been created in Cycle 2 with additional acres created from spillover. Each of the cycles should help protect the area from saltwater intrusion. The specific goal of creating marsh that settles to 2.5 ft MLG (1.2 ft NAVD88 (Geoid99)) has been achieved in Cycle 1 and in the southern end of the Cycle 3.

## b. Recommended Improvements

No improvements are currently being recommended.

## c. Lessons Learned

Dredge containment cells near the Browns Lake area, within the Sabine National Wildlife Refuge will vegetate without the addition of vegetative plantings. The Cycle 3 area vegetated as quickly as the Cycle 1 area and did so from seed bank alone. It is not necessary to pre-dig trenasses for tidal ingress and egress. Rather, the track hoe/marsh buggy can be driven over the area where tidal channels are desired approximately one year after pumping to create channels. Pre-digging trenasses is costly and can interfere with the placement of the dredged material.

Post-construction as-built surveys should be conducted on the dredge material cycles at pre-determined intervals. The surveys should be replicable and should include a design that is cost effective and aids in determining settlement rates over time within each cycle.

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