Coastal Protection and Restoration Authority of Louisiana

State of Louisiana

Coastal Protection and Restoration Authority (CPRA)

2015 Operations, Maintenance, and Monitoring Report

for

Grand-White Lake Land Bridge Protection

State Project Number ME-19
Priority Project List 10

May 2015
Cameron Parish

Prepared by:
Margaret Luent
and
Melvin Guidry

Coastal Protection and Restoration Authority
Lafayette Field Office
635 Cajundome Boulevard
Lafayette, LA 70506

Suggested Citation:

Luent, M. and M. Guidry. 2015. *2015 Operations, Maintenance, and Monitoring Report for Grand-White Lake Land Bridge Protection (ME-19),* Coastal Protection and Restoration Authority of Louisiana, Lafayette, LA. 24 pp and appendices.

2015 Operations, Maintenance, and Monitoring Report
For
Grand-White Lake Land Bridge Protection (ME-19)

Table of Contents

Preface

This report includes monitoring data collected through October 2013, and annual Maintenance Inspections through May 2012. The Grand-White Lake Land Bridge Protection (ME-19) project is federally sponsored by the U.S. Fish and Wildlife Service (USFWS) and locally sponsored by the Coastal Protection and Restoration Authority of Louisiana (CPRA) under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA, Public Law 101-646, Title III). ME-19 is listed on the 10th CWPPRA Priority Project List (PPL-10).

The 2015 report is the 4th report in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to previous OM&M reports (2005, 2007, and 2011) as well as annual O&M inspection reports (2005-2012) on the CPRA website: http://cims.coastal.la.gov/

I. Introduction

The Grand-White Lake Land Bridge Protection project (ME-19) is a shoreline protection project from the 10th priority list of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA), comprised of 1,530 ac (619 ha) of fresh marsh and open water in the Mermentau Basin of Cameron Parish, Louisiana. The project area includes shoreline along a portion of the southeast Grand Lake, the northern half of Collicon Lake shoreline, and Round Lake (Figure 1). In 2001, 35% of the project area was classified as fresh marsh and 65% as open water shrub/scrub (Linscombe and Chabreck n.d.; obtained from the Coastwide Reference Monitoring System (CRMS) website (http://www.lacoast.gov/crms_viewer/) on August 30, 2011). Soils in the area between Grand Lake, Collicon Lake, and adjacent to the old GIWW are Larose muck. The northeastern shore of Collicon Lake consists of organic Allemands muck. Both Larose muck and Allemands Muck are very poorly drained soils and are extremely vulnerable to erosion when exposed to hydrologic energy (USDA 1995).

Grand Lake and Collicon Lake are in danger of breaching into each other endangering the 13,281 acre (5374.6 ha) Grand-White Lake Land Bridge area. Wave induced erosion of the southeast shoreline of Grand Lake (15 mi/24.1 km northwest fetch) and the west shoreline of Collicon Lake (2 mi/3.2 km southeast fetch) has removed the lake rims and is endangering the narrow land bridge between the two lakes which is less than 450 ft (140 m) wide at the narrowest point. Measurements of shoreline loss at 10 transects at the southeast portion of Grand Lake yielded loss rates from 23.9-36.2 ft (7.3-11.0 m) per year (Clark et al. 1999). Without the project, the small strip of marsh separating Collicon and Round Lake could be lost and the entire project area could become part of Grand Lake. Consequently, shoreline erosion would accelerate in the marsh between the former Collicon Lake and Alligator Lake and Lake Le Bleu as the shorelines of Grand Lake and White Lake advance towards each other through the Grand-White Lake Land Bridge.

The objective of the project is to prevent the coalescence of Grand, Collicon, and Round lakes by:

a. Stopping erosion along the southeastern shoreline of Grand Lake and the northern and western shorelines of Collicon Lake.

b. Creating a total of 17 acres of emergent marsh along the southeastern shoreline of Grand Lake and 10 acres of emergent marsh along the northern and western shorelines of Collicon Lake.
c. Reducing erosion along the southern shoreline of Round Lake by 50 %.

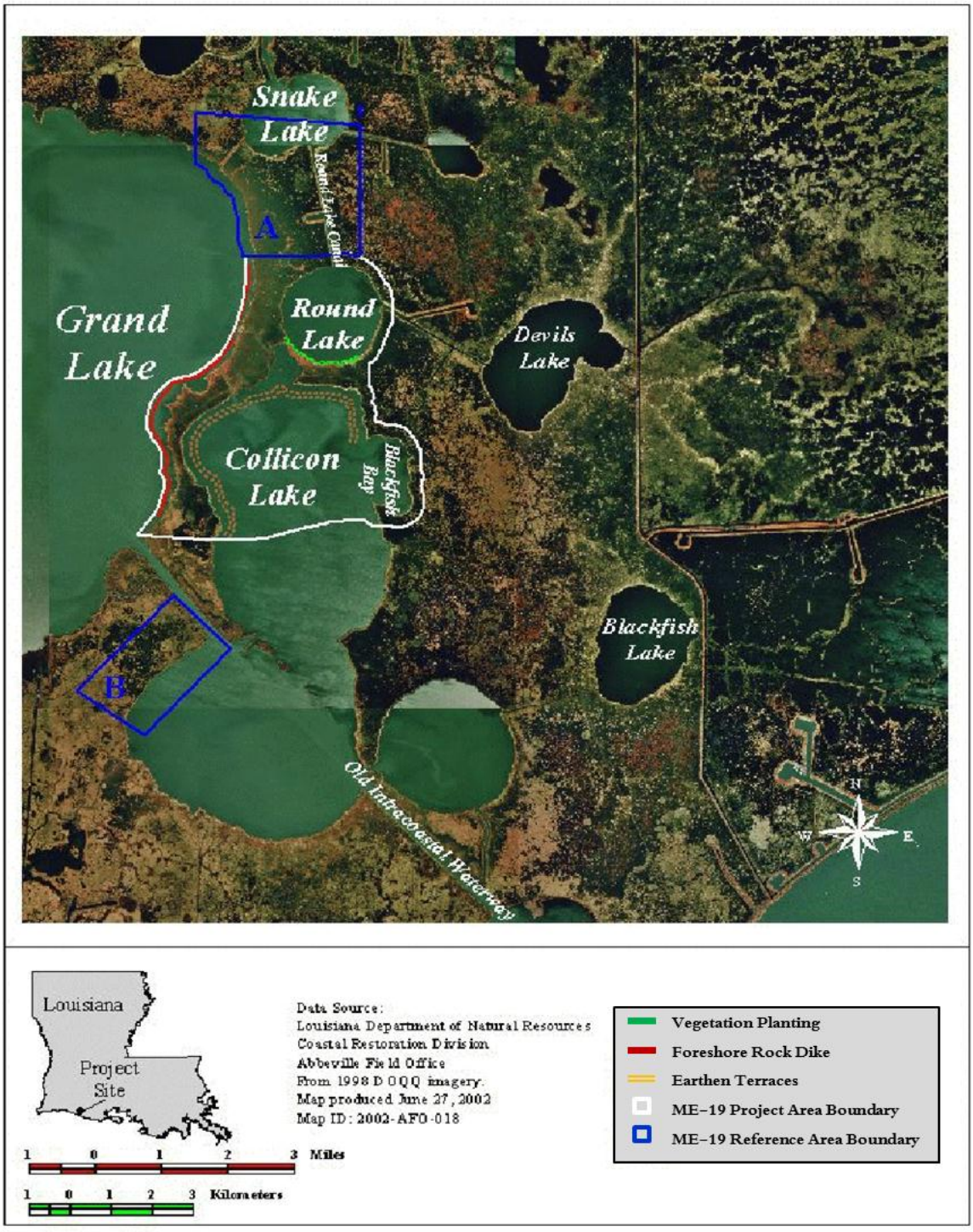

Figure 1. Grand-White Lake Bridge Protection (ME-19) project and reference areas showing shoreline planting, shoreline stabilization, and terrace locations.

The project features designed to attain the objectives were divided into two construction units.

Unit 1, Grand Lake Shoreline Stabilization, features included installation of a foreshore dike with gaps constructed from limestone lakeward of the southeastern Grand Lake shoreline. Subaerial land was created in open water behind the foreshore dike with access channel dredged material during construction. More specifically, construction in this unit included the following items:

1. Excavation of a barge access canal lakeward of the foreshore dike;

2. Placement of 12,024 ft (3,666 m) of limestone rock as a foreshore dike 150 – 250 ft (45.72–76.2 m) lakeward of the shoreline with 50 ft (15 m) gaps every 700–1,000 ft (213.36–304.8 m) for hydrologic connectivity and fish and wildlife access. Initial dimensions of the foreshore dike were 2.5 feet NAVD 88 (~1 ft [0.30 m] above average water level), a 3 ft wide crown, a 29 ft (8.84 m) or less base width, and 3:1 side slopes;

3. Dredged material from the access canal was used to create subaerial land behind the foreshore dike; the material was seeded to reduce erosion and enhance marsh establishment (Clark and Dubois 2003).

In Unit 2, the Collicon Lake Terraces, earthen terraces were constructed to reduce erosion of fringing fresh marsh, create marsh, facilitate marsh building by trapping suspended sediments in adjacent shallow open water, and stimulate the growth of submerged aquatic vegetation. Unit 2 construction features consist of the following items.

1. Construction of two parallel rows of 83-385 foot (25-117 m) long terrace segments (92 total segments), with gaps between each segment. Total length was 19,544 ft (5,959 m). The lakeside terraces were intended to be sacrificial to protect the inner marshside terraces long enough for the inner terraces to fully revegetate.

2. Planting of terrace tops with three rows of *Paspalum vaginatum* (seashore paspalum) planted on 5 ft (1.52 m) centers. Terrace side slopes were planted with *Zizaniopis miliacea* (giant cutgrass) in one row on 5 ft (1.52 m) centers. The side slope facing Collicon Lake had two rows on 5 ft (1.52 m) centers.

3. Planting along the southern shoreline of Round Lake included one row of *Z. miliacea* alternated with *Schoenoplectus californicus* (California bulrush) on 5 ft (1.52 m) centers for a total distance of 4,000 ft (1,219.2 m).

Construction of the foreshore rock dike, Unit 1, was initiated in July 2003 and completed in November 2003. Construction of the lake terraces, Unit 2, was initiated in July 2004 and completed in September 2004.II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Grand-White Lakes Landbridge Protection Project (ME-19) is to evaluate the constructed project features, 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 Grand-White Lakes Landbridge Protection Project (ME-19) was held on May 17, 2012 under clear skies and mild temperatures. In attendance were Mel Guidry, Stan Aucoin, Darrell Pontiff and Jody White of CPRA. Representatives of (USFWS) were unable to attend. The boat was launched on Miami Corporation property at Superior Canal. The annual inspection began at approximately 10:30 a.m. at the south end of the rock dike along the east shoreline of Grand Lake.

The field inspection included a complete visual inspection of all project features. Staff gauge readings were not available to determine approximate elevations of water, earthen terraces, rock dike, 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 any notable deficiencies (see Appendix C).

b. Inspection Results

Grand Lake Shoreline Protection

The foreshore rock dike feature is in excellent condition. Warning signs are present. There is vegetation behind the rock dike over the majority of length of dike. No maintenance is required at this time (Photos: Appendix A, Photo 1-3).

Collicon Lake Terraces

Marsh side and lake side earthen terraces along Collicon Lake continue to experience erosion. Several terraces along the northwest and west shoreline of Collicon Lake are no longer visible. (Photos: Appendix A, Photo 5) The northern and southern most sections of terraces

are flourishing with Roseau Cane; however, it was difficult to distinguish by boat whether two rows of terraces remain (Photos: Appendix A, Photo 4 &6).

II. Maintenance Activity (continued)

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

ii. Programmatic/ Routine Repairs

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since September 2004, the construction completion date of the Grand-White Lake Landbridge Protection Project (ME-19).

2009 Stream Wetland Services, LLC – The lakeside earthen terraces were planted with 3,242 Roseau Cane plants to help with erosion of the terraces. The work was completed in March of 2009. The costs associated with this maintenance event were as follows:

E&D (performed by CPRA)	$ 5,000.00
Construction Contract	$24,120.48
TOTAL	**$29,120.48**

III. Operation Activity

a. Operation Plan

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

b. Actual Operations

No water control structures are 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 Coastwide Reference Monitoring System-*Wetlands* (CRMS) for CWPPRA, updates were made to the

ME-19 Monitoring Plan 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. There are two CRMS sites adjacent to the ME-19 project area (CRMS0595 to the northeast and CRMS0584 to the south) and another site within the Grand-White Lake Land Bridge area (CRMS0574). To account for the rapid erosion of terraces, revisions to the monitoring plan were finalized on June 15, 2011 (McGinnis 2011) and are adapted in this report.

a. Monitoring Goals

The objective of the Grand-White Lake Land Bridge project is to prevent the coalescence of Grand and Collicon Lakes by preventing erosion and creating emergent marsh along the southeastern shoreline of Grand Lake and the north and western shorelines of Collicon Lake along with reducing erosion along the southern shoreline of Round Lake by 50 %.

The following monitoring strategies will be used to evaluate progress towards the project objectives for this report:

1. Evaluate changes in Land: Water ratios.
2. Evaluate rate of erosion along the eastern shoreline of Grand Lake and the north western shoreline of Collicon Lake.
3. Evaluate establishment of emergent vegetation on planted terraces.

b. Monitoring Elements

Aerial Photography

To evaluate the extent of marsh creation and erosion within the project and reference areas, near-vertical, color-infrared aerial photography (1:12,000 scale) was obtained as built in November 2004 ("as-built" following terrace construction) and in post-construction year 2014. The photography was georectified, mosaicked, and land/water ratios determined using standard operating procedures described in Steyer et al. (1995, revised 2000). To compare to the historical context of the ME-19 project area, % land area data archived in CRMS website (http://www.lacoast.gov/crms_viewer/) was used generate percent land change trends for ME-19 area before (1932-2004) and after (2004-2010) project construction.

To provide historical context for the ME-19 land bridge, the land change analysis (1956-1998) performed by the USGS for the environmental assessment of this project (Clark and Dubois 2003) was expanded through 2013 and includes a pre- versus post construction analysis of change rates. Distances from ten transects crossing the land bridge between Grand and Collicon/Round Lakes (Figure 2, Table 1) were measured over time from aerial photography (historical pre-construction: 1956, 1978, 1988, 1994, 1998; post construction: 2004, 2005, 2007, 2008, 2010 and 2013). The historical pre-construction data was compiled from the environmental assessment, and the post construction data was collected from imagery on the SONRIS GIS platform. Cumulative change starting from 1956 was averaged from all transects and plotted. Change rates were determined via linear regression for each transect

then averaged to compare pre- versus post construction periods with a least square means ANOVA (SAS Institute Inc. 2010).

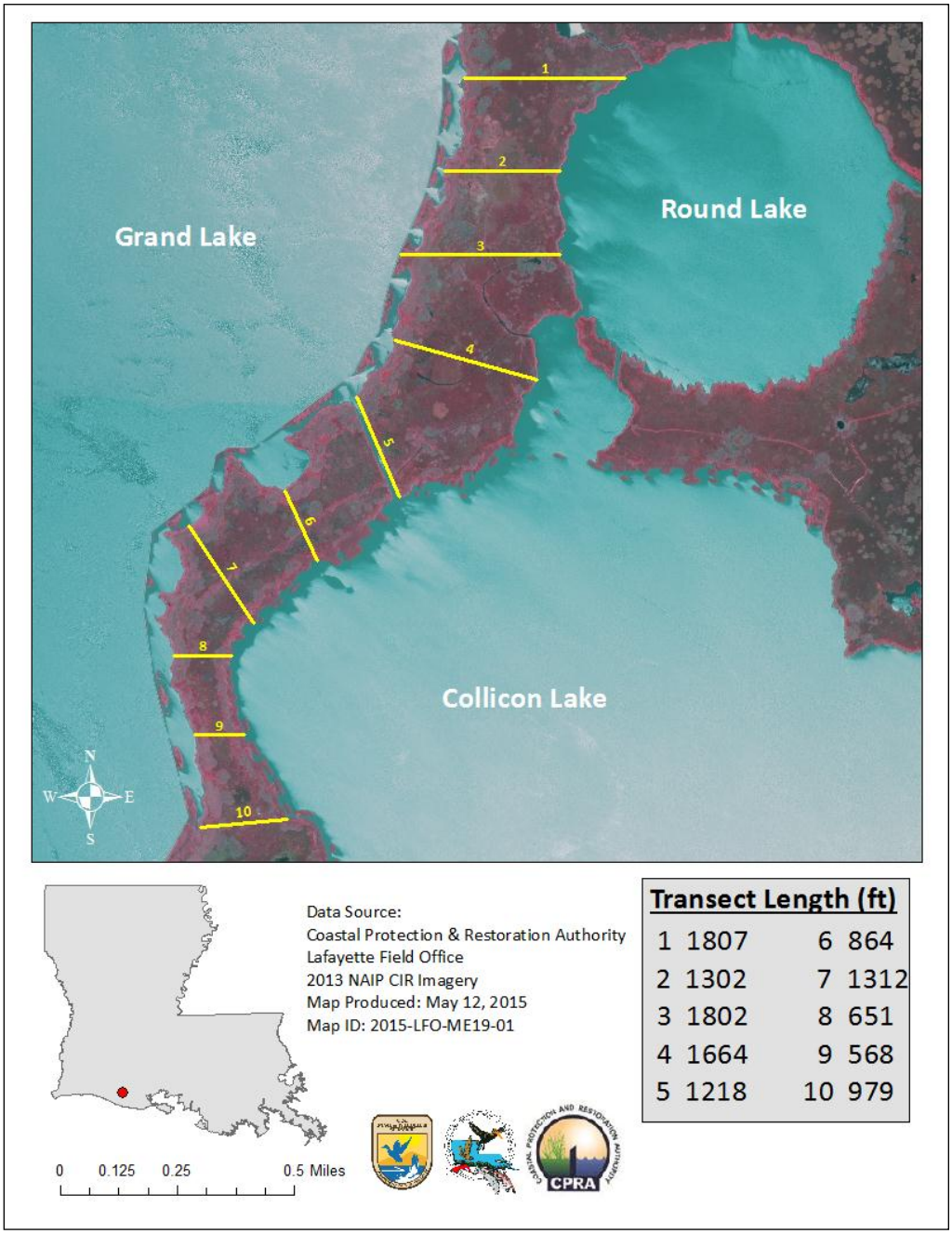

Figure 2. Updated transect lengths from 2013 NAIP color infrared Imagery.

Table 1. Land bridge transect gain or loss 1998-2013.

1998 Transect lengths (ft)	2013 Transect lengths (ft)	Transect gain/loss (ft)
1734	1807	+73
1252	1302	+50
1629	1802	+173
1620	1664	+44
1348	1218	-130
813	864	+51
1037	1312	+275
648	651	+3
422	568	+146
954	979	+25

Shoreline Change

To document shoreline movement, differential GPS was used to map the shoreline in both the project (behind the project features) and reference areas (Steyer et al. 1995). Contiguous, emergent vegetation was used to delineate the shoreline. Shoreline mapping behind the foreshore dike and its reference area was conducted in November 2003 (as built) and August 2006 (post construction). Shoreline mapping behind the earthen terraces and its reference area was conducted in October 2004 (as built). Post construction shoreline mapping behind the foreshore dike and terraces was conducted in October 2008 and 2013 and will be conducted in late summer/early Fall 2021. 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, and change rates (EPR, m/y) were determined between dates of interest (Thieler et al. 2009).

Terrace Vegetation

The condition of the natural emergent, seeded, and planted vegetation on the Lake Collicon terraces is monitored at 10% of the total planted terraces over the life of the project. Twelve terraces were grouped by potential wave exposure, six are lakeside terraces (higher exposure) and six are marsh side terraces (lower exposure). Four sampling stations were established on selected terraces consisting of a station on the inner and outer slope and two stations on the crown. At each station (4 m^2 sample area) species composition, percent cover (total and by species), and dominant plant heights were documented (Steyer et al. 1995). Each station was marked with two corner poles to allow for revisiting the sites over time. Vegetation was evaluated at the sampling sites in the fall of 2004 (as built) and 2005 (post construction). Sampling was scheduled to continue in 2008, 2013, and 2021; however, by 2008 many of the terraces (especially the lakeside terraces) had eroded to the point that the permanent vegetation stations did not exist.

Because the permanent vegetation stations are eroding with the terraces, the evaluation of terrace vegetation was changed to a more adaptable method than fixed stations. Vegetation on the twelve terraces used for the initial vegetation evaluation is documented over the entire terrace rather than permanent vegetation stations. Previous vegetation data (2004 and 2005)

collected from permanent vegetation stations were combined to describe each terrace and compare to future vegetation data. A full factor ANOVA of terrace position (lakeside, marsh side) and time (2004, 2005, 2010, and 2013) was used to compare species richness and total percent cover (SAS Institute Inc. 2010). In addition, vegetated portions of the twelve terraces are mapped to compliment the terrace vegetation evaluation and track the condition of the terraces over time concurrent with shoreline mapping. The twelve terraces are mapped using differential GPS (Steyer et al. 1995) as conducted for shoreline mapping. Terrace vegetation evaluation and mapping was conducted in March 2010, October 2013, and is scheduled for 2021. Terrace areas were calculated from As-built drawings (September 2004), digitized aerial photography (November 2005), and dGPS mapping (May 2010 and October 2013) to describe changes over time. Because the lakeside terraces were built larger than the marsh side terraces, percent area change within each time interval was used for statistical analysis in full factoral ANOVA of position (lakeside, marsh side) and time interval (2004-2005, 2005-2010, 2010-2013). In addition to the 10% of terraces selected for vegetation assessment, the survival of all terraces was quantified. An assessment of percent of terraces remaining each year since construction was conducted by overlaying a 2005 terrace polygon layer over present imagery in Google Earth. If any vegetation was visible within the polygon, then the terrace was considered present; if no vegetation was visible, then it was considered absent.

c. Monitoring Results and Discussion

Aerial Photography

Baseline aerial photography for the project area was flown on November 25, 2004 immediately following terrace construction (Figure 3). The total project area was 32% land; the reference area for the foreshore dike (to the north) was 76% land, and the reference area for the terraces (to the south) was 63% land. Land to water analysis to evaluate land change and compare among areas was conducted post construction in 2014 (Figure 4). The total project area increased to 34% land while both reference areas decreased slightly in land area. The northern reference area is 75% land and the southern reference area is 62% land. Percent land area stored on the CRMS website (http://lacoast.gov/crms_viewer2/Default.aspx#) was used to provide a historical perspective within the ME-19 project area; ME-19 was losing -0.33 % of land prior to construction (1932-2004) while land loss had slowed post construction (2004-2010) to -0.02 %/y with the addition of terraces and dredge spoil deposition. Based on the land area change map from Couvillion et al. (2011), pre-construction loss appeared to be more associated with shoreline erosion, whereas post construction loss is more associated with interior marsh loss.

In a historical perspective within the project area, the rate of change in the land-bridge width differed significantly as the land bridge quickly narrowed during pre-construction (1956-2004: -22.2 ft/y [6.6 m/y]) and slowly broadened during post-construction (2004-2013: + 5.9 ft/y [1.8 m/y]) periods (F_1=3927.1; p<0.0001) (Figure 5). An example of this is at the narrowest width of the land bridge (Transect 9) which shrunk from 1,405 ft (428 m) in 1956 to 422 ft (129 m) in 1998 then broadened to 456 ft (+ 8%) (139 m) in 2010. Since 2010, it has broadened further to 568 ft (+ 34.5%) (173m). Between 2010 and 2013 the overall rate of change for the land bridge was + 18.5 ft/yr. This land gain resulted from several of the marsh side terraces merging with the land bridge.

Shoreline Change

From construction to 2008 the only area to gain land was the project area behind the rock dike on Grand Lake (1.9 m/yr). The rock dike reference area, Collicon Lake project area and reference area had all displayed land loss (-.33, -.06, and -1.26 m/yr, respectively). Since 2008, land has continued to erode in both Grand Lake and Collicon Lake reference areas (-0.8 and -0.9 m/yr, respectively). However, there has been land expansion behind the Grand Lake rock dike (3.6 m/yr) and the Collicon Lake project area (2.3 m/yr). 2013 shoreline mapping revealed several terraces had expanded and merged with the existing shoreline along Collicon Lake (Figure 6). These terraces had vegetation growth that was clearly rooted and not simply floating on the water surface.

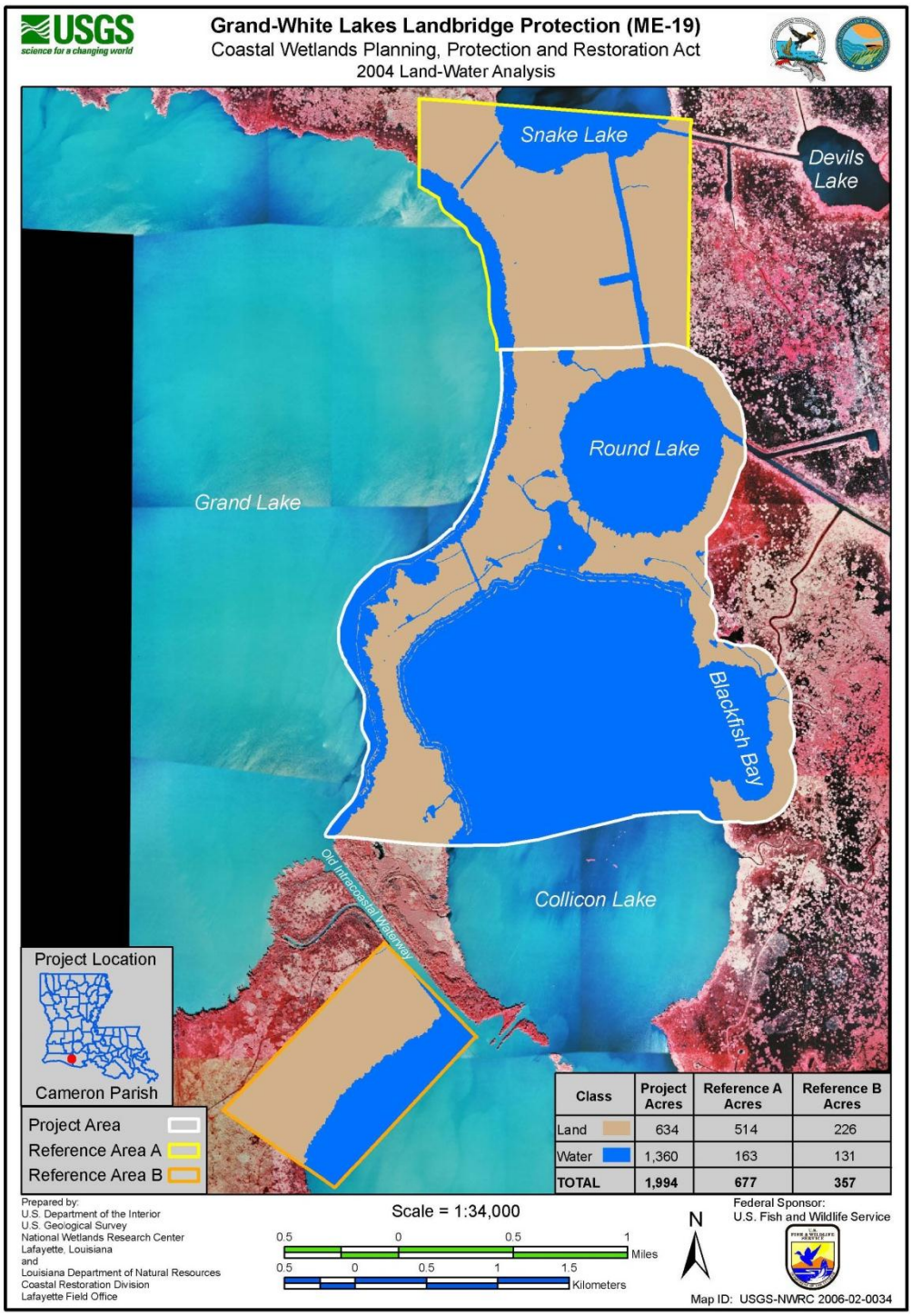

Figure 3. Land to water analysis for Grand-White Lake Landbridge Protection (ME-19), project flown November 24, 2004 following completion of construction.

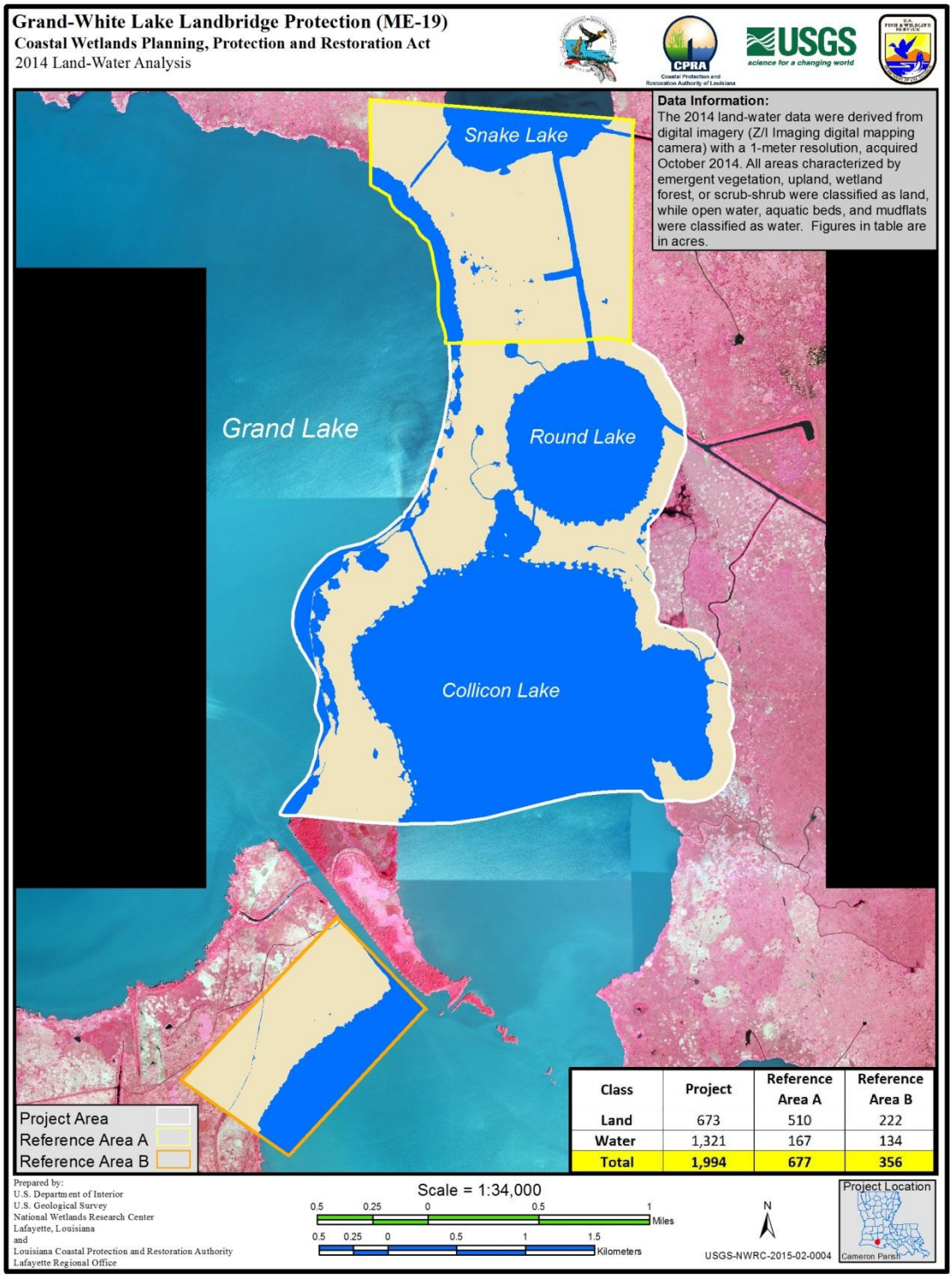

Figure 4. Land to water analysis for Grand-White Lake Landbridge Protection (ME-19) project, flown October 2014 post- construction.

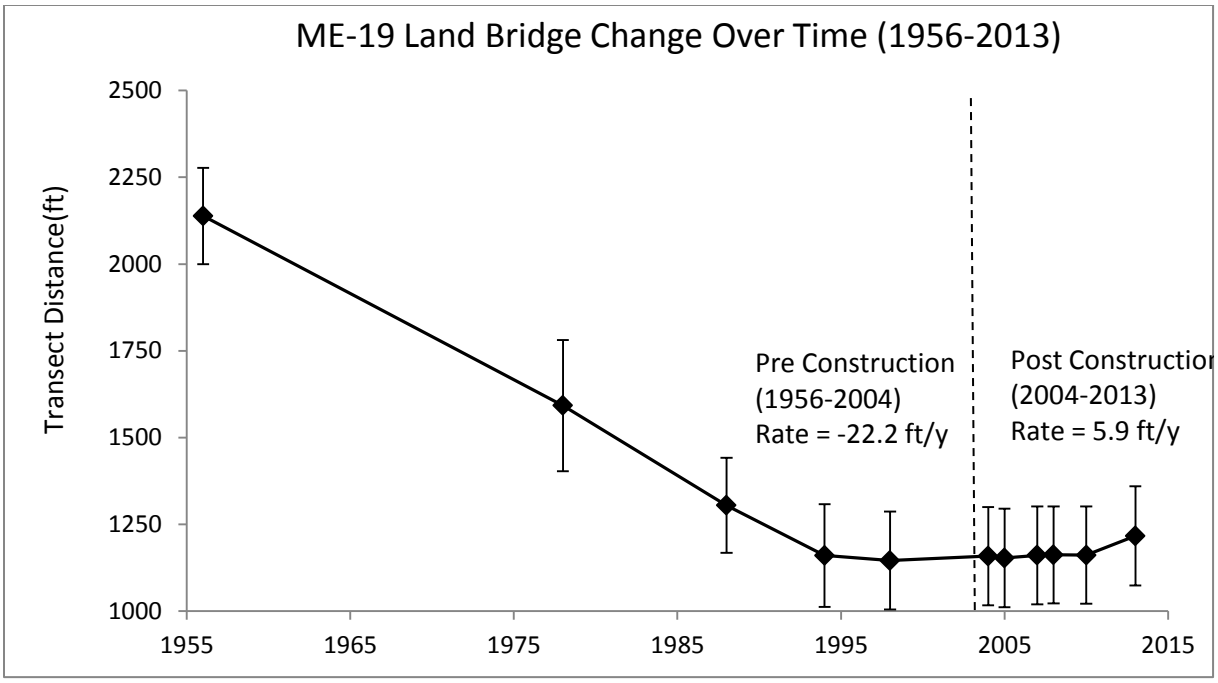

Figure 5. Historical and post construction change in land bridge width over time (1959-2013) in the ME-19 project area. The values are the means (±1 SE) for cumulative change in distance of transects (t_i-t_0) since 1959 (n=10).

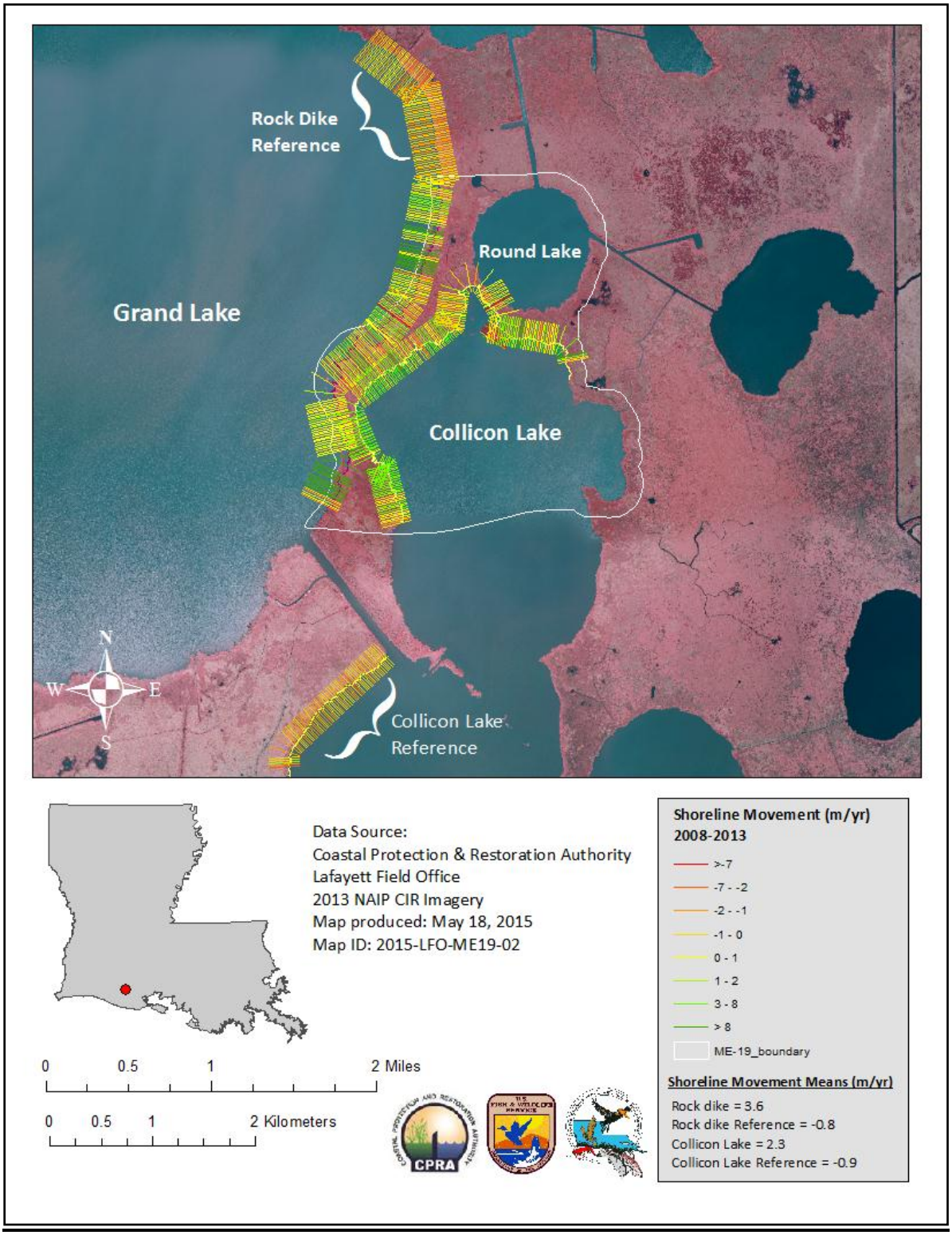

Figure 6. Shoreline mapping was conducted behind project structures (foreshore rock dike along Grand Lake and terraces along Collicon Lake) and corresponding reference areas of the ME-19 project area soon after construction (foreshore rock dike, November 2003; terraces, October 2004) and in October 2013. Shoreline movement rates (mean, m/y) were calculated from 20 m spaced transects along Grand Lake and Collicon Lake; negative change rates indicate loss while positive change rates indicate gains.

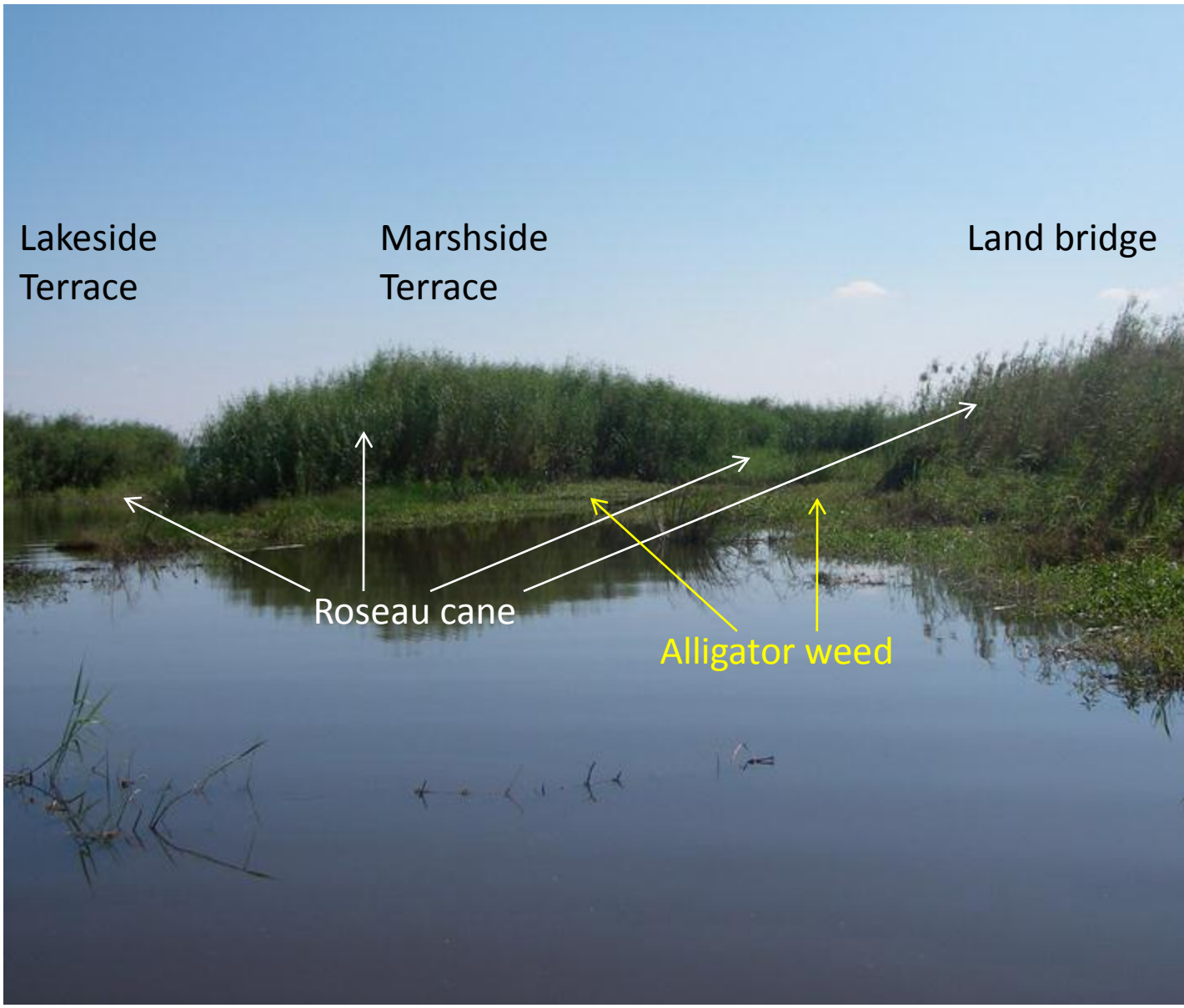

Figure 7. Vegetation along Collicon Lake expands as terrace and land-bridge vegetation merge. At the time of this photograph (October 21, 2008) the vegetation between the land-bridge and terrace was floating; therefore, the vegetative expansion was not included in the shoreline change analysis. If the merging vegetation anchors into the soil below, then it will be considered emergent and define the vegetated shoreline of the land bridge.

Terrace Vegetation

The intended plan for the Lake Collicon terraces was to use the larger, lakeside terraces (LS) as sacrificial protection to allow the smaller, marsh side terraces (MS) to become established and fortified with vegetation. Based on tallies of available aerial imagery, half (50%) of the LS terraces are still remaining while 100% of the marsh side terraces remain (Figure 8) as of 2014. This indicated that the lakeside terraces, while sacrificial, helped protect the marshside terraces from erosion. The sharp decline of LS terraces from 2005 to 2007 is attributed to immaturity of the plantings in a highly exposed environment and the effects of Hurricane Rita.

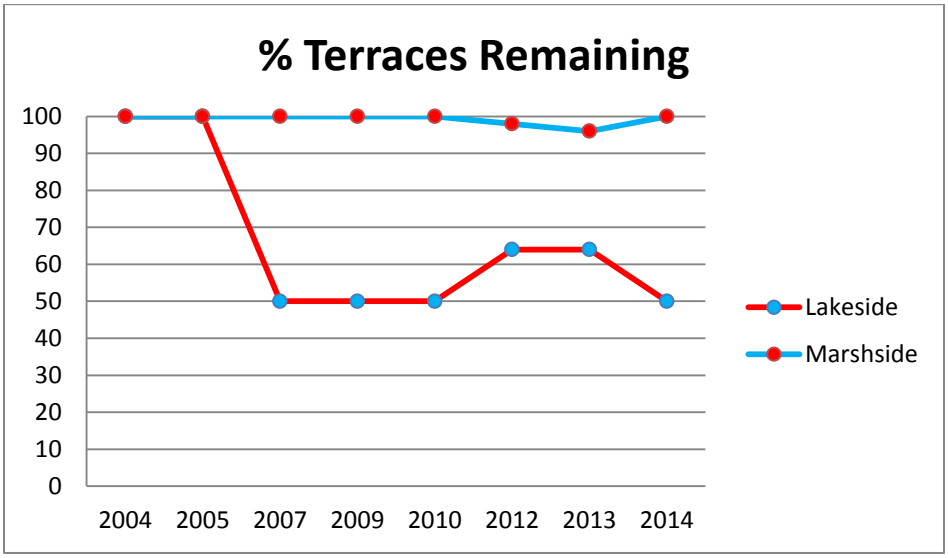

Figure 8. Percentages of terraces with vegetation remaining since construction in 2004. Half of the lakeside (sacrificial) terraces remain while all the marsh side terraces are still intact.

At the twelve terraces used for vegetative evaluation (6 LS and 6 MS), the percent vegetated area of the terraces changed differently by position (lakeside and marsh side) over time intervals based on a robust, full factoral Analysis of Variance terrace position (lakeside and marsh side) and time intervals; the greatest effect was Time Interval while the Position × Time Interval effect was significant (Table 2). Terraces in both positions lost land area through March 2010, and then gained area from March 2010 to October 2013 (Figure 9). The greatest terrace area loss rate occurred at the LS terraces during the initial time period (September 2004 to November 2005) and is attributed to immaturity of the plantings in a highly exposed environment and the effects of Hurricane Rita.

Initially after construction (2004-2005), terrace area sharply eroded as the sacrificial LS terraces buffered the MS terraces. Erosion slowed, but continued at both terrace positions from 2005 to 2010 (Figure 10). From 2010 to 2013, LS and MS terraces increased in area, 57%/yr and 30%/yr, respectively (Figure 9). Expansion of terraces from 2010 to 2013 is attributed to Roseau cane expansion on terrace remnants (Figure 11). The LS terraces added a greater % of area because they had more of an open footprint on the terrace to recolonize.

The MS terraces had approximately the same vegetated area as they had when constructed (Figure 9).

Table 2. Analysis of Variance (ANOVA) results from full factorial analyses of terrace position (lakeside and marsh side) and time intervals (2004-2005, 2005-2010, and 2010-2013) effects for percent area change rates (%/y) at ME-19. Significant (*) differences are set at α=0.05.

Source	df	F-ratio	p-value
Position	1	0.05	0.8332
Time Interval	2	57.27	<.0001*
Position x Time Interval	2	8.01	0.0014*

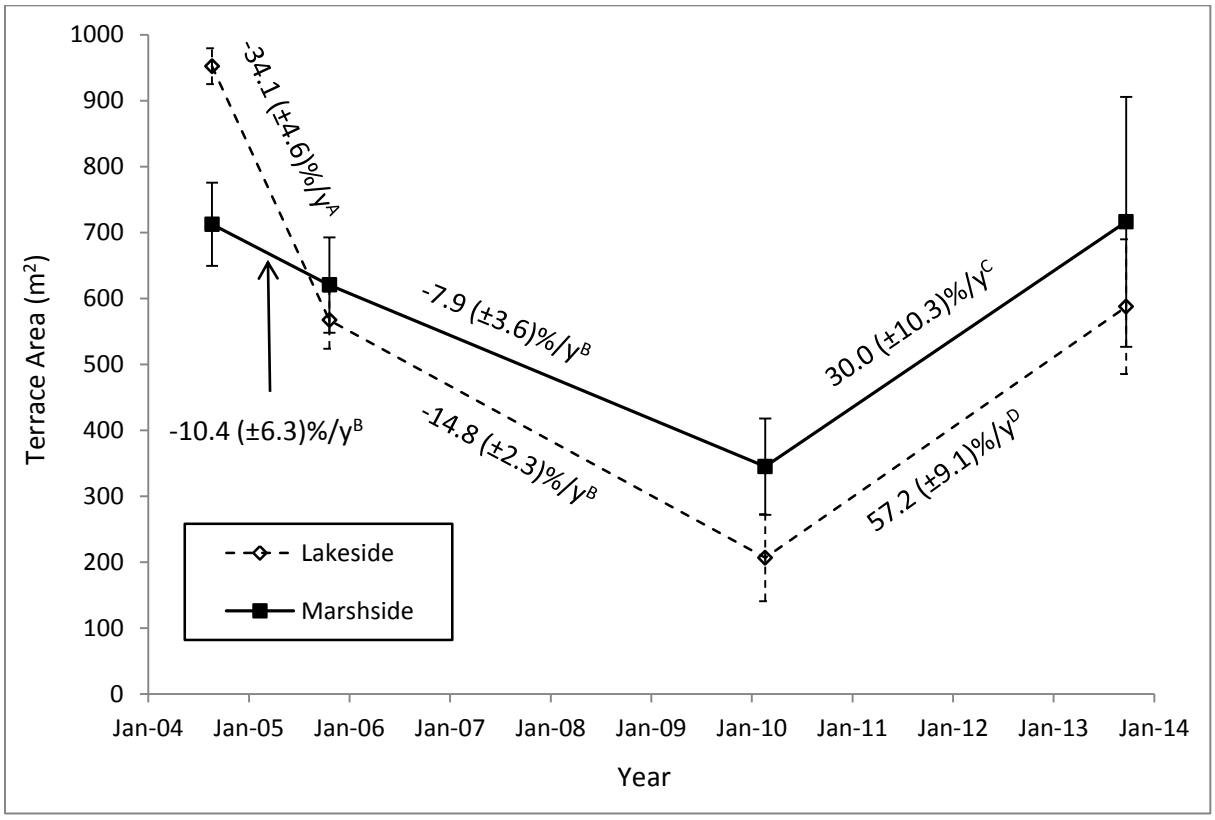

Figure 9. Terrace areas were determined for the Collicon Lake terraces for September 2004 (as-built), November 2005, March 2010 and October 2013. Rates of change (values over lines) interactions were compared for terrace location (lakeside and marsh side) by time intervals (2004-2005, 2005-2010, 2010-2013); different superscript letters indicate significant difference among the rates.

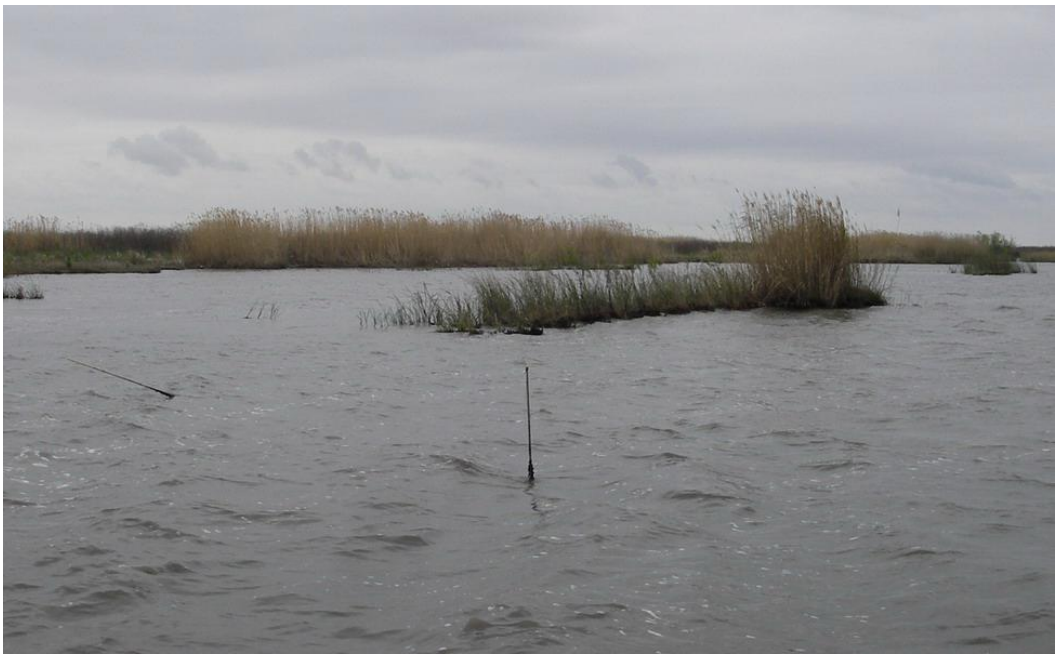

Figure 10. Many terraces have eroded since construction, especially the lakeside terraces (e.g. LS42) which were intended to be sacrificial and buffer the marsh side terraces. Note the cane poles that mark the original corners of the terrace. Picture was taken on March 24, 2010.

Figure 11. October 2, 2013 photograph of LS42 (shown above in 2010), a lakeside terrace, depicting vegetation growth. Note the expansion of Roseau cane since the 2010 photography.

Vegetation has matured over time on the remaining terrace area as both species richness and percent vegetative cover increased since construction; however, since 2010, there has been a decline in species richness for both types of terraces, about 4.8 species (71%) less on MS terraces and 1.4 (33%) species less on LS terraces, with richness on the MS terraces falling below that on the LS terraces (Table 3; Figure 12). Percent vegetation covers for both terrace types are on the rise and have reached 100% coverage.

Zizaniopsis miliacea (terrace slopes) and *Paspalum vaginatum* (terraces crowns) planted in 2004 have persisted and were found on more than half of the remaining terraces in 2013 (Figure 14). *Echinochloa crus-galli,* which had been manually seeded on the crown, did not occur in the 2005 sampling but was found on one marsh side terrace in 2010 and was gone by 2013. The total richness of plant species increased over time as the vegetative communities on the terraces matured through 2010 and decreased from 2010 to 2013 (Figure 14). The occurrence and coverage of *Phragmites australis* (Roseau cane) increased over time. Of the 12 terraces used for this report, Roseau cane had not been planted during construction; it occurred at only 1 terrace (lakeside) in 2005, and by 2010, Roseau cane occurred on all but 1 terrace (marsh side), and by 2013 occurred on all terraces (Figures 13 and 14).

Table 3. Analysis of Variance (ANOVA) results from full factorial analyses of terrace position (marsh side, MS; lakeside, LS) and time (2004, 2005, 2010 and 2013) effects for species richness and percent total cover of terrace vegetation at ME-19. Significant differences are set at α=0.05 (*). Time was the only significant factor in both richness and cover.

		Species Richness			Percent Vegetative Cover		
Effect	df	F-Ratio	p-value	Post Test	F-Ratio	p-value	Post Test
Position	1	2.8	0.1015		0.47	0.4963	
Time	3	8.6	0.0001*	’10 > others	205	<.0001*	’13 > ’10 >’04,’05
Position × Time	3	2.4	0.0853		0.4	0.7918	

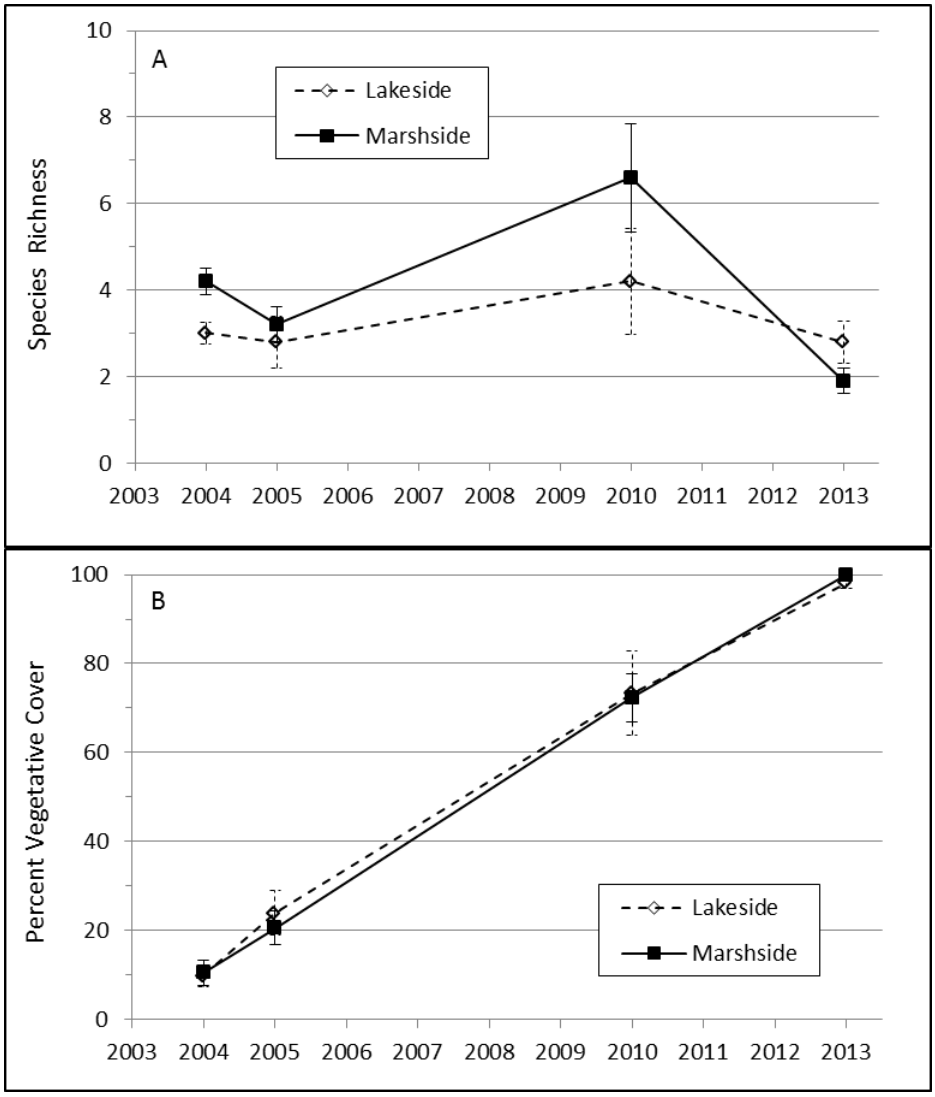

Figure 12. Species richness (A) and percent vegetative cover (B) over time collected on terraces along Lake Collicon in ME-19. Values are means and standard errors of 6 terraces. No significant differences are noted.

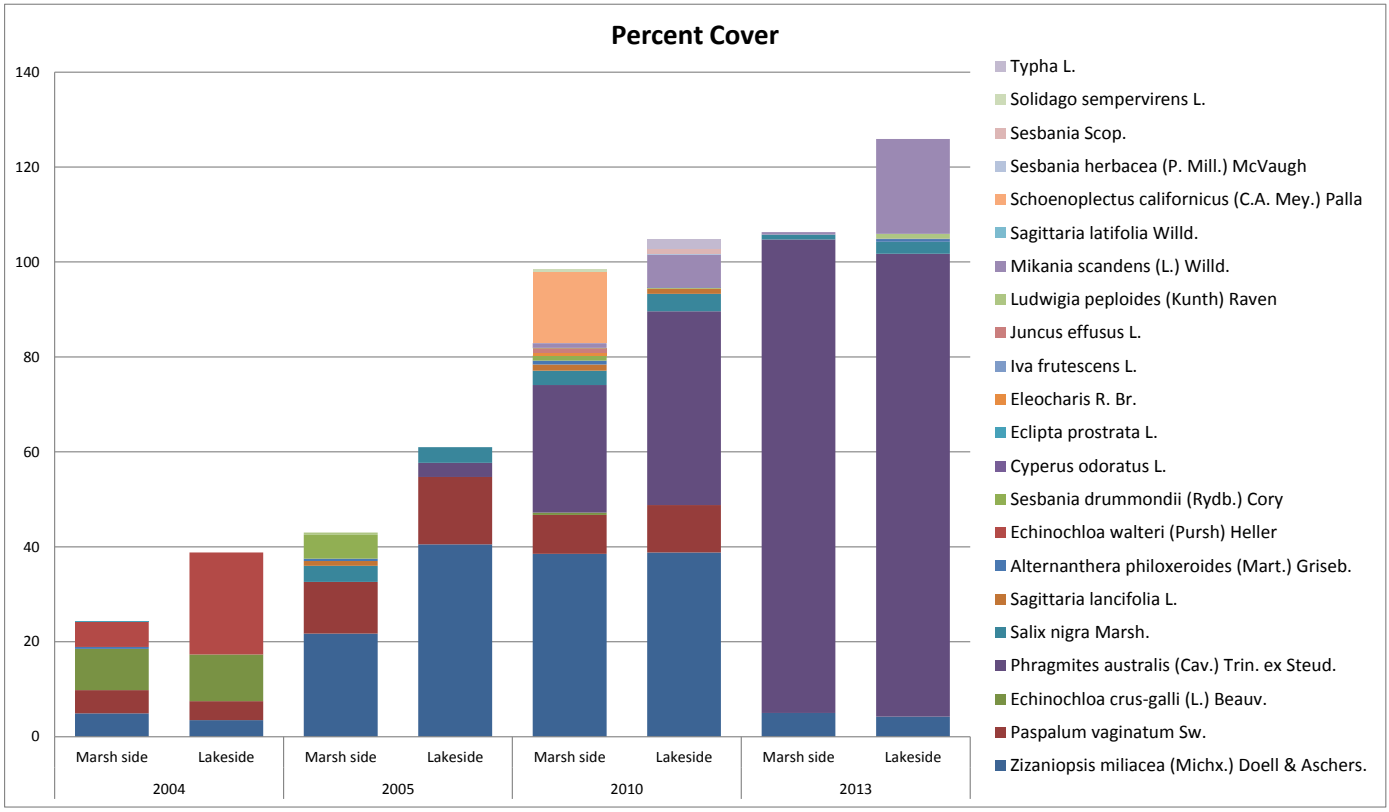

Figure 13. Vegetation observed on lakeside and marsh side terraces along Collicon Lake over time in ME-19 project area. Values are the percent area coverage (% Cover).

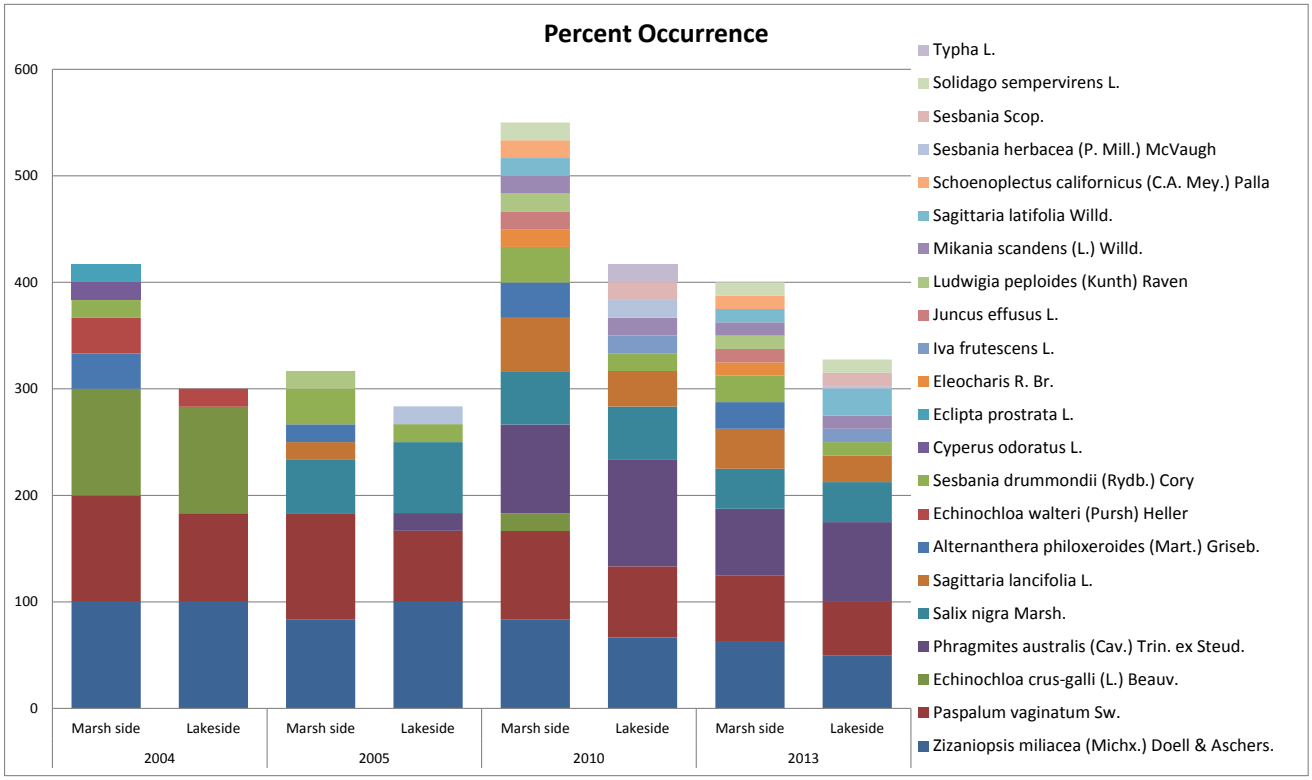

Figure 14. Vegetation observed on lakeside and marsh side terraces along Collicon Lake over time in ME-19 project area. Values are the percent occurrence (% Occurrence).

Conclusions

a. Project Effectiveness

The Grand/White Lake Land Bridge Protection project (ME-19) is on track to achieve the main objective to prevent the coalescence of Grand, Collicon, and Round Lakes within the 20 year project life (2003-2023). The width of the land bridge between the foreshore dikes along Grand Lake and the terraces along Collicon Lake/plantings along Round Lake has broadened since project construction. Towards the specific project goals:

1. Shoreline change rates behind both project structures were significantly higher than their reference shorelines. The foreshore rock dike has not only stopped erosion but has gained land along the southeastern shoreline of Grand Lake, and the earthen terraces have significantly reduced erosion and gained land on the northern and western shorelines of Collicon Lake. Several marsh side terraces have merged with the landbridge increasing land acreage along Collicon Lake as well. However, many outer terraces have eroded and, without armoring, the inner terraces and land bridge can be expected to erode as well.

2. As of 2013, the goals of creating 17 acres of emergent marsh along the eastern shoreline of Grand Lake and 10 acres of emergent marsh along the northern and western shorelines of Collicon Lake have been accomplished. Since 2008 approximately 33 acres along Grand Lake and 17 acres along Collicon Lake have been established.

b. Recommended Improvements

None at this time.

c. Lessons Learned

Although the lakeside terraces were initially effective at buffering the marsh side terraces, the high rate of lakeside terrace loss has made the marsh side terraces vulnerable. The wind fetch across Collicon Lake from all directions is large enough to allow for the sizeable wave generation that has degraded the earthen terraces. However, the lakeside terraces were supportive long enough to allow expansion of several marsh side terraces into the landbridge. In terms of vegetation used as armor, *Phragmites australis* (Roseau cane) has been effective in maintaining terraces thus far.

Literature Cited

Clark, D. R., C. Allen, and C. Brodnax 1999. Grand-White Lake Land Bridge Protection Project (PME-18) Candidate Project Information Sheet for Wetland Value Assessment, October 4, 1999. U.S. Department of the Interior, Fish and Wildlife Service. Lafayette, LA. 21 pp.

Clark, D. R., and R. Dubois. 2003. Final Environmental Assessment: Grand-White Lakes Land Bridge Protection Project (PME-18/ME-19) Cameron Parish, LA. U.S. Department of the Interior, Fish and Wildlife Service. Lafayette, LA. 36 pp.

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.

Linscombe, G. and R. Chabreck. n.d. Task III.8—Coastwide aerial survey, brown marsh 2001 assessment: Salt marsh dieback in Louisiana—Brown marsh data information management system, accessed June 4, 2006, at http://brownmarsh.net/data/III_8.htm

McGinnis, T. 2011. *Monitoring for Grand-White Lake Land Bridge Protection (ME-19).* Louisiana Office of Coastal Protection and Restoration, Operations Division, Lafayette Field Office, Lafayette, LA. 11pp.

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 program. Open-file series no. 95–01 (Revised June 2000). Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division. 97 pp.

Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan. 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/.

U. S. Department of Agriculture, Soil Conservation Service 1995. Soil survey of Cameron Parish, Louisiana. Publication No. 1995–386–441/00020. Washington, D. C.: U. S. Government Printing Office. 135 pp, 122 maps. Scale 1:20,000.

APPENDIX A
(Inspection Photographs)

Photo No. 1, Rock Dike and Signs on East Shoreline of Grand Lake

Photo No. 2, Vegetation and Rock Dike on East Shoreline of Grand Lake

Photo No. 3, Rock Dike on East Shoreline of Grand Lake

Photo No. 4, Earthen Terraces on North End of Collicon Lake

Photo No. 5, Earthen Terraces on Northwest and West Sides of Collicon Lake

Photo No. 6, Earthen Terraces on Southwest End of Collicon Lake

APPENDIX B
(Three Year Budget Projection)

GRAND-WHITE LAKES LANDBRIDGE/ ME-19 / PPL 10

Three-Year Operations & Maintenance Budgets 07/01/2015 - 06/30/2018

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Pat Landry	*Mel Guidry*	*USFWS*	*Mel Guidry*

	2015/2016 (-11)	2016/2017 (-12)	2017/2018 (-13)
Maintenance Inspection	$ 6,851.00	$ 7,057.00	$ 7,269.00
Structure Operation			
State Administration		$ -	$ -
Federal Administration		$ -	$ -
Maintenance/Rehabilitation			

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.	$ -

17/18 Description:

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

	2015/2016 (-11)	2016/2017 (-12)	2017/2018 (-13)
Total O&M Budgets	**$ 6,851.00**	**$ 7,057.00**	**$ 7,269.00**

O &M Budget (3 yr Total)	**$ 21,177.00**
Unexpended O & M Budget	**$ 1,065,627.00**
Remaining O & M Budget (Projected)	**$ 1,044,450.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

GRAND-WHITE LAKES LANDBRIDGE / PROJECT NO. ME-19 / PPL NO. 10/ 2015-2016

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,851.00	**$6,851.00**
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**

ADMINISTRATION

LDNR / CRD 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	
Bank Paving	0	0.0	0	$0.00	$0.00
	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		LUMP	0	$0.00	$0.00
Vegetative Plantings		EACH	0	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: $6,851.00

OPERATION AND MAINTENANCE BUDGET WORKSHEET

GRAND-WHITE LAKES LANDBRIDGE / PROJECT NO. ME-19 / PPL NO. 10/ 2016-2017

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$7,057.00	**$7,057.00**
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**

ADMINISTRATION

LDNR / CRD 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	
Bank Paving	0	0.0	0	$0.00	$0.00
	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		LUMP	0	$0.00	$0.00
Vegetative Plantings		EACH	0	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: $7,057.00

OPERATION AND MAINTENANCE BUDGET WORKSHEET

GRAND-WHITE LAKES LANDBRIDGE / PROJECT NO. ME-19 / PPL NO. 10/ 2017-2018

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

ADMINISTRATION

LDNR / CRD 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:	Vegetative plantings on terraces.				
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Bank Paving	0	0.0	0	$0.00	$0.00
	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		LUMP	0	$0.00	$0.00
Vegetative Plantings		EACH	0	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: $7,269.00

APPENDIX C
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-19 Grand-White Lake Landbridge

Date of Inspection: May, 17 2012 Time: 10:30 am

Structure No.

Inspector(s): Mel Guidry, Stan Aucoin, Darrell Pontiff, and Jody White (CPRA)

Structure Description: Rock Dike and Earthen Terraces

Water Level Inside: Outside: _____

Type of Inspection: Annual

Weather Conditions: Sunny and mild

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	N/A				
Rip Rap (fill) Rock Dike	Excellent			1 - 3	Rock dike is in very good shape. Vegetation is healthy behind rock dike.
Earthen Terraces	Fair			4-6	Terraces are eroding and will require maintenance.

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?