State of Louisiana
Department of Natural Resources
Coastal Restoration Division and
Coastal Engineering Division

2007 Operations, Maintenance, and Monitoring Report

for

Holly Beach Sand Management Project

State Project Number CS-31
Priority Project List 11

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Cameron Parish

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I. Introduction

The Holly Beach Sand Management (CS-31) project area is located between the communities of Holly Beach and Constance Beach on the Gulf of Mexico shoreline of southwestern Louisiana, west of Calcasieu Pass in Cameron Parish (figure 1). The project area is comprised of approximately 10,849 acres (4,426 ha), of which 8,900 acres (3,603 ha) are classified as wetlands (U.S. Geological Service, National Wetlands Research Center [USGS-NWRC] 2001). The project area is divided into two areas separated by the Louisiana Highway 82 embankment, which is built on a chenier ridge. Area A includes approximately 8,600 acres (3,481 ha) of brackish and intermediate marsh located along the north side of the highway. Area B includes approximately 300 acres (121 ha) of beach dune and coastal chenier habitat located south of the highway along 8.0 miles (12.9 km) of beach between Holly Beach and Ocean View Beach.

Chronic erosion in this area is caused by a deficit of sand and sediment in the littoral transport system due to stabilization of the Mississippi River and regulation of the Atchafalaya River to the east (U.S. Department of Agriculture, Natural Resources Conservation Service and Louisiana Department of Natural Resources [USDA-NRCS and LDNR] 2001). In addition, the Calcasieu and Mermentau rivers are not supplying coarse grained sediment (sand) to the area, and the Cameron jetties associated with the Calcasieu Ship Channel deflect what little material that exists away from the project area (Byrnes et al. 1995, Byrnes and McBride 1995).

Today, this ridge is the only remaining hydrologic barrier separating thousands of acres of low energy, intermediate and brackish marsh along the southern boundary of Sabine National Wildlife Refuge (SNWR) from the high energy, saline waters of the Gulf of Mexico. The highway revetment has already been undermined and repaired in some sections, and the underlying chenier is in danger of being breached. A breach of this ridge would lead to direct wave erosion and saltwater intrusion into fragile, low energy wetlands in Area A to the north.

In Area B, the intent of the project is to modify the design of 18 existing breakwaters on the west end of the breakwater field and remove 6 experimental breakwaters located landward of existing breakwaters 35 through 40, to enhance their sediment trapping capability. In addition, utilizing the beneficial placement of sand dredged from offshore, the beach will be widened and a sub-aerial beach profile will be re-established that will reduce the occurrence of wave over-wash of the chenier-beach ridge.

The breakwater modifications, which were funded by the state of Louisiana, were completed on June 19, 2002. The removal of the experimental breakwaters was completed on September 5, 2002. Approximately 1,750,000 cubic yards (1,600,200 cu meters) of coarse grained sand were pumped from a distance of 5 miles offshore between Holly Beach and OceanView Beach. Construction of the sand-pumping portion of the project was initiated in July 2002 and was expected to be completed in November 2002. Inclement weather and equipment problems delayed completion until March 2003. Construction of 18,797 linear feet of sand fencing on the eastern end of the project parallel to Louisiana Highway 82 was completed in March 2003, and

installation of 18,400 gallons of *Panicum amarum* (Bitter Panicum) was completed in August 2003. Shortly thereafter, another 11,000 linear feet of sand fencing was installed on the western portion of the project.

Hurricane Rita struck the coast of Louisiana on September 24, 2005, with maximum storm surge of 14-15 ft (4.3 – 4.6m) in the CS-31 project area. USGS calculated the amount of land that changed to water resulting from the storm to be 98 square miles in southwestern Louisiana, with 22 square miles of land lost in the Calcasieu/Sabine basin (USGS News Release October 3, 2006). This land loss can be attributed to several patterns. Shearing, which is ripping and removal of marsh vegetation in historically healthy marshes, was observed north of Johnson's Bayou and south of the Sabine National Wildlife Refuge. The removal of remnant marsh from areas with historical land loss from the surge was observed in the marsh just north of Johnson's Bayou and north of Mud Lake.

Figure 1. Holly Beach Sand Management (CS-31) project area boundaries.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Holly Beach Sand Management Project (CS-31) 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, LDNR 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 C.

An inspection of the Holly Beach Sand Management Project (CS-31) was held on October 30, 2006, under sunny skies and cool temperatures. In attendance were Stan Aucoin, Pat Landry, Herb Juneau, and Darrell Pontiff from LDNR and Dale Garber from NRCS. The annual inspection began at approximately 10:30 a.m. on the western boundary of the project area.

The field inspection included a complete visual inspection of all features. Staff gauge readings where available were used to determine approximate elevations of water, sand dunes, and sand fencing. Photographs were taken at each project feature (see Appendix B) and Field Inspection notes were completed in the field to record measurements and deficiencies (see Appendix D).

b. Inspection Results

Beach Nourishment:

The entire reach of the 28,000 linear feet of the beach fill area appeared very clean and was without significant areas of scattered debris. Recent strong southerly winds and extremely high tides pushed most of the small debris against the high bank or roadside embankment, or carried same away via westerly currents. The sand fill was judged to be in excellent shape, considering the severity of Hurricane Rita, with the majority of the "plateau area" that was initially constructed still in place. Post-Rita surveys and cross sections were performed and compared to pre-Rita surveys. The results indicate that an approximate quantity of 427,000 cubic yards of sand material have been removed by Rita. Beyond the western end of the project, we observed that some significant amounts of sand material had been deposited onto areas adjacent to the beach. Also, the prevailing westerly currents have deposited sand along the coast west of the original project boundary as per visual observation and recent 2005 aerial photography. The original "vegetative plantings" portion of the project was severely impacted by Hurricane Rita and has since been partially replanted at no cost to LDNR by the Louisiana Department of Agriculture and Forestry. The recent high water event has caused the new plants to become

somewhat stressed, but over time they are expected to recover. (Photos: Appendix B, Photos 1 and 2).

Sand Fence:

The entire initially installed sand fence was destroyed by Hurricane Rita and a Sand Fence Repair Maintenance Project to replace 46,000 linear feet is currently underway as noted in Section II. d. below. The contractor has removed all of the existing fence posts, wire, and debris for offsite removal. Approximately 1,200 posts of the initial fence were salvaged for reuse on the new fence. All of the posts have been installed for the primary fence alignment, and at the time of this inspection, the contractor was starting to hang new sand fence material starting at the eastern end of the project. The secondary fence alignment has been partially staked out. The contract time ends on March 12, 2007; however, the contractor completed the project on November 27, 2006. (Photos: Appendix B, Photos 3, 4, and 5).

II. Maintenance Activity (continued)

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

None at this time.

ii. Programmatic/ Routine Repairs

None at this time.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since April 2003, the construction completion date of the Holly Beach Sand Management Project (CS-31).

April 2005 - The La. Dept. of Agriculture and Forestry along with the Cameron Parish Police Jury installed approximately an additional 18,800 linear feet of sand fencing along with approximately 4,000 plants in April 2005.

July 2006 – The La. Dept. of Agriculture and Forestry installed approximately 5,550 plants along the entire length of the beach project.

October 2006 – Sand Fence Replacement (FEMA Project) – A maintenance event is currently underway to replace 46,000 linear feet of sand fence destroyed by Hurricane Rita. The contractor is Landscape Management Services from Lake Charles, La. Work began on October 9, 2006, and the contract time ends on March 12, 2007. The cost associated with the engineering, design, and construction of the Holly Beach Sand Fence Maintenance Project is as follows:

Construction:	$ 218,473.50
Engineering & Design:	$ 10,000.00
Construction Admin./Oversight	$ 10,000.00
As builts:	$ 8,797.50
TOTAL CONSTRUCTION COST:	**$ 247,271.00**

Note: This maintenance project was completed on November 27, 2006. The final quantity of sand fence installed was 46,239 linear feet.

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 Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Task Force decision on August 14, 2003, to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS-*Wetlands*) for CWPPRA, updates were made to the CS-21 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 the Breaux Act. There are two CRMS-*Wetlands* stations in the CS-31 project area. Data collected from these stations will be used in future reports to determine marsh response in Area A to project features and environmental variables.

a. Monitoring Goals

The objective of the Holly Beach Sand Management Project is to protect approximately 8,600 acres (3,481 ha) of existing low energy, intermediate and brackish wetlands north of the chenier/beach ridge between Holly Beach and Constance Beach and to protect approximately 300 acres (121 ha) of beach dune and coastal chenier habitat along the shoreline from erosion and degradation caused by high energy wave action from the Gulf of Mexico.

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

1. Evaluate the beach response to sand nourishment and modification of 18 existing breakwaters after 2 years to facilitate re-evaluation of the existing breakwater design and the ability of the constructed beach profile to reduce predicted over-wash events.

2. Determine shoreline position to assess project-effectiveness at maintaining the shoreline (high water/rack line along beach ridge) seaward of its pre-nourishment position for the first 5 years (for breakwaters 10 through 72).

3. Determine shoreline position to assess project-effectiveness at maintaining shoreline (high water/rack line along beach ridge) seaward of its pre-nourishment position for an additional 5 years should the beach need re-nourishment.

4. Evaluate water salinity in the project area north of the beach/ridge, Area A, for effects of over-wash occurrences.

5. Evaluate maintenance of existing intermediate and brackish marsh vegetation in Area A, the project area north of the chenier/beach ridge.

6. Evaluate condition of the *Panicum amarum* plantings along the project area shoreline.

b. Monitoring Elements

Aerial Photography:
To measure marsh and open water areas (in Areas A and B), near-vertical color-infrared aerial photography (1:12,000) was acquired pre-construction in December 2001, December 2002 (since project completion was delayed) and October 2005. 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 personnel according to standard procedures (Steyer et al.1995, revised 2000). Photography will also be obtained in post-construction year 7 in 2010. Additional photography may be obtained in response to storm events.

Bathymetry/Topography:
To document both horizontal and vertical change along the project area shoreline, transect lines used to measure elevation were established parallel and perpendicular to the breakwaters, and tied in to a known elevation datum by professional surveyors. These transect lines were surveyed incrementally pre-construction in 2002-2003, and immediately post-construction in March 2003 and were surveyed in August 2005 and post-Hurricane Rita in January 2006.

Vegetation Plantings:
The general condition of the *Panicum amarum* (Bitter Panicum) plantings in Area B was documented using a generally accepted methodology similar to Mendelssohn and Hester (1988), Coastal Vegetation Project, Timbalier Island. Plots were chosen by randomly selecting numbers based on the coordinates within the project area to represent a 10 % sample of the plantings. The GPS coordinates were used to mark one corner of a plot of 16 plants to determine % survival by counting live plants within each plot, dividing by the total number of plants, and multiplying by 100. Ocular estimates of percent canopy cover were recorded for each plot. The percent cover for each plot was broken down into the percent cover provided by the *P. amarum* plantings, by other wetland species and by upland species. These criteria were documented in the fall of 2003 and in the spring and fall of 2004. The possibility of herbivore damage is recognized and will be recorded if observed.

Shoreline Change:
To document shoreline movement between Holly Beach and Constance Beach, differential global positioning system (DGPS) surveys of unobstructed sections of the shoreline were conducted using the high water/rack line as the vegetative edge. DGPS shoreline positions were mapped and used to measure shoreline erosion/growth rates. Shoreline change rates were used to calculate the average ft/yr gained/lost along the project area shoreline. Surveys were conducted immediately post-construction in 2003, in the fall and spring of 2003, 2004, and 2005, and in the fall of 2006 and will be conducted twice per year in the fall and spring of 2007, 2009, and 2011 post-construction.

Water Salinity:
To assist in determining the frequency that high salinity water enters the interior marsh in Area A from wave over-wash, three continuous recorders were installed to collect hourly salinity data,

one at the southern end of Cowboy ditch, one adjacent to the low section of Louisiana Highway 82 with concrete block revetment between Peveto Beach and Holly Beach, and one in a marsh pond on the east side of the project area (figure 1). Hourly salinity data have been collected at these three stations pre-construction, from September 2002 to February 2003, and 3 years post-construction, from March 2003 to March 2006. Data collected from these stations will be compared to hourly salinity data collected from the Sabine Refuge Structure Replacement (CS-23) project and the USGS realtime data recorder in Calcasieu Lake near Cameron, Louisiana, to aid in determining the origin of high salinity water entering the project area. The CS-23-01R data has been collected by personnel from Sabine National Wildlife Refuge and provided to LDNR since March 2004.

Emergent Vegetation:

To document the condition of the emergent vegetation in the project area over the life of the project, vegetation was monitored at 30 sampling stations established along 3 transect lines within Area A. Using the Braun-Blanquet methodology outlined in Steyer et al. (1995), percent cover, species composition, and dominant plant height were documented in replicate 2 m by 2 m sampling plots established at each station. A pole installed in one corner of each plot allows for locating and reevaluating established plots over time. Descriptive observations of SAV will be noted during monitoring of emergent vegetation. Vegetation was monitored once pre-construction in 2002 and post-construction in the fall of 2003, 2004, and 2005 and will be monitored in the fall of 2009. Data were also collected in the fall of 2006 to document the effects of Hurricane Rita.

Porewater Salinity:

At each Emergent Vegetation station, we also attempted to obtain soil porewater salinity data, utilizing the sipper method, down to 10 cm below the soil surface. Data were collected pre-construction in 2002 and post-construction in the fall of 2003, 2004, and 2005 and will be collected in the fall of 2009.

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

Aerial Photography:

Land to water analysis was completed for the pre-construction photography acquired in November 2001 and December 2002 and post-construction acquired in October 2005 (figures 2-5). Results indicated 81.58% land and 18.41% water within the project area in 2001, 82.75% land and 17.25% water in 2002, and 82.37% land and 17.54% water in 2005 (in both Areas A and B). The difference between the 2001 and 2002 analyses was due to the partial construction of the beach at the time of the 2002 photography. The 2005 analysis followed Hurricane Rita and showed approximately 30 acres of land lost, mostly along the shoreline.

Bathymetry/Topography:

A Geographic Information System (GIS) database was developed to facilitate the data processing and analysis phase of this investigation. Substantial data processing was required to prepare survey coordinate data for beach profile analysis. Survey data were imported to ArcGIS and reprojected to a Universal Transverse Mercator (UTM) coordinate system for surface interpolation. A triangulation-based (TIN) digital terrain model was then generated from each survey in order to produce two interpolated surfaces for comparison.

Shoreline position change rates were calculated using the Digital Shoreline Analysis System (DSAS Ver. 3.2). Shoreline position was defined as the location of the 2.55 foot contour along the beach. Inspection of the beach profiles indicated that the 2.55 foot contour tended to coincide with a distinct break in slope along the upper beach. This position is an interpretation of the upper limit of wave activity at high tide; relative to geomorphology, this position is generally recognized as the berm crest or a scarp at the toe of the dune (see Byrnes and Hiland 1995). Transect start points were generated using a baseline created by drawing a straight line north of the beach, running parallel to the beach (for breakwaters 10 through 72). Transects were placed perpendicular to the baseline, spaced 20 m apart, and measured from the baseline to the shoreline position at the 2.55 ft contour within each survey. Shoreline change was calculated by subtracting the August 2005 shoreline position from the January 2006 shoreline position. The data indicate that the shoreline retreated at an average of 21 ft/yr during this time period (figures 6a and 6b).

Vegetation Plantings:

Data were collected on October 6, 2003, April 20, 2004, and October 12, 2004 (Table 1, figures 7 & 8). Mean percent survival and mean percent cover in the fall of 2003 were 82.5 and 13.07, respectively. In the spring of 2004 mean percent survival was 81.1% and mean percent cover was 26.7%. Mean percent survival dropped to 76.7% in the fall of 2004, while mean percent cover increased to 46.4% (figure 8). Many of the original plants were actually covered by the dune that formed behind the fences. The dunes were becoming colonized by both *Panicum amarum* and other species as well. The last scheduled monitoring of the vegetation plantings occurred in the fall of 2004. As documented in the inspection report though, the plantings were severely impacted by Hurricane Rita and were replanted by the La. Dept. of Agriculture and Forestry. No monitoring is scheduled for the new plantings. The condition of the vegetation plantings and dunes will be documented using O&M surveys.

Shoreline Change:

Data were collected in the spring and fall of 2003, 2004, and 2005 and the fall of 2006. No monitoring was scheduled for 2006, but a survey was conducted to evaluate the effects of Hurricane Rita. The data indicate an average loss of 6.12 ft/yr between the spring 2003 and spring 2004 surveys. This period would be considered the initial adjustment period after construction when the beach is taking its shape. The beach was expected to quickly degrade during this time period due to an overfill of sand by the contractors. The pre-Hurricane Rita data (spring 2003 to spring 2005) indicate an average loss rate of 17.72 ft/yr. The post-Hurricane Rita survey (comparing spring 2005 to fall 2005) showed an average of 46.33 ft/yr was lost during the storm (figure 10). Comparing the fall 2005 to spring 2006, which would be

considered the recovery period after the impact, indicated an average loss rate of 41.47 ft/yr. Average loss across all surveys (spring 2003 to spring 2006) was 25.87 ft/yr (figure 9). These shouldn't be taken individually as an actual indication of loss rates along the beach, but rather an indication of the processes occurring along the beach. Unlike the bathymetric/topographic surveys, these shoreline surveys can be influenced by tide levels considering the gentle slope of the beach (1:40 during construction) and the fact that elevation isn't taken into account during data collection. Tide levels during the surveys are presented in Table 2. Loss rates appear to be fairly uniform across the project area in most surveys. However, the post-Hurricane Rita data indicate greater loss rates along the eastern side of the beach and some gain along the western end (figure 10). The hurricane appears to have shifted large amounts of sand to the western side.

Salinity/Water Level:

Hourly salinity and water level have been collected at the following continuous recorder stations (figures 11-13). Water levels are surveyed to NAVD 88:

Station	Data collection period
CS31-01	9/10/02 – present
CS31-02	2/18/03 – present
CS31-03	2/18/03 – present

The project goals for salinity were to maintain levels within the intermediate to brackish range of 3-12 ppt (figure 12). Yearly means of all project area recorders were less than 3 ppt through 2004. Monthly means at all project area stations stayed within the target range until Hurricane Rita struck in September. CS31-02 was the only recorder that continued to log through the hurricane where salinities reached 24 ppt. Monthly salinity means remained above 20 ppt at stations CS31-01 and CS31-02 until December 2005 (figure 13). CS31-03 wasn't redeployed until March 2006. In July 2006, monthly salinities returned to normal and remained below 7 ppt for the remainder of 2006. Data from station CS20-15R in the East Mud Lake Marsh Management (CS-20) reference area, which reflects conditions in Calcasieu Lake, are presented for comparison. The data from this recorder were used since the recorder at CS23-01R didn't collect data for much of 2005 and 2006. Yearly mean salinities at this recorder were below 12 ppt for the years preceding Hurricane Rita. However, following Rita, monthly mean salinities remained around 15 ppt even once salinities in the project area returned to normal. This indicates that the project area may not be affected by salinity fluctuations in the Calcasieu Ship Channel.

Water level data didn't indicate any overwash events other than the surge from Hurricane Rita. Station CS31-02 recorded water levels at 4.77 ft NAVD 88 before the recorder stopped logging accurately during this event.

Emergent Vegetation:

The project goal for emergent vegetation was to maintain existing vegetation community as that typical for intermediate and brackish marsh in project Area A north of the chenier/beach ridge. The dominant species in all surveys were *Spatina patens* and *Paspalum vaginatum*. Other frequently occurring species were *Schoenoplectus americanus*, *Schoenoplectus robustus*, *Typha* spp. and *Distichlis spicata*. These species would fit into either the Olighohaline Paspalum or Oligohaline Wiregrass classification described by Visser et al. (2000) (Table 3, figure 14).

Total percent cover for the pre-construction survey in 2002 was 87%. The cover dropped slightly for 2003 and 2004 but was essentially the same in both years at 76%. Following Hurricane Rita, cover dropped dramatically to 7% but recovered in 2006 to 63% (figure 15).

Porewater Salinity:

In the 2002 survey, we were able to obtain soil porewater salinity data at all 30 emergent vegetation stations. Mean salinity of all stations was 3.32 ppt. However, in 2003, due to the hardness of the ground, we weren't able to obtain data at any stations. In 2004, we obtained data at 14 of the 30 stations, which recorded a mean salinity of 3.18 ppt. The mean salinity in 2005 was 16.59 ppt at 28 stations. We could only obtain data at two stations in 2006. These stations had a mean of 13.2 ppt (figure 16).

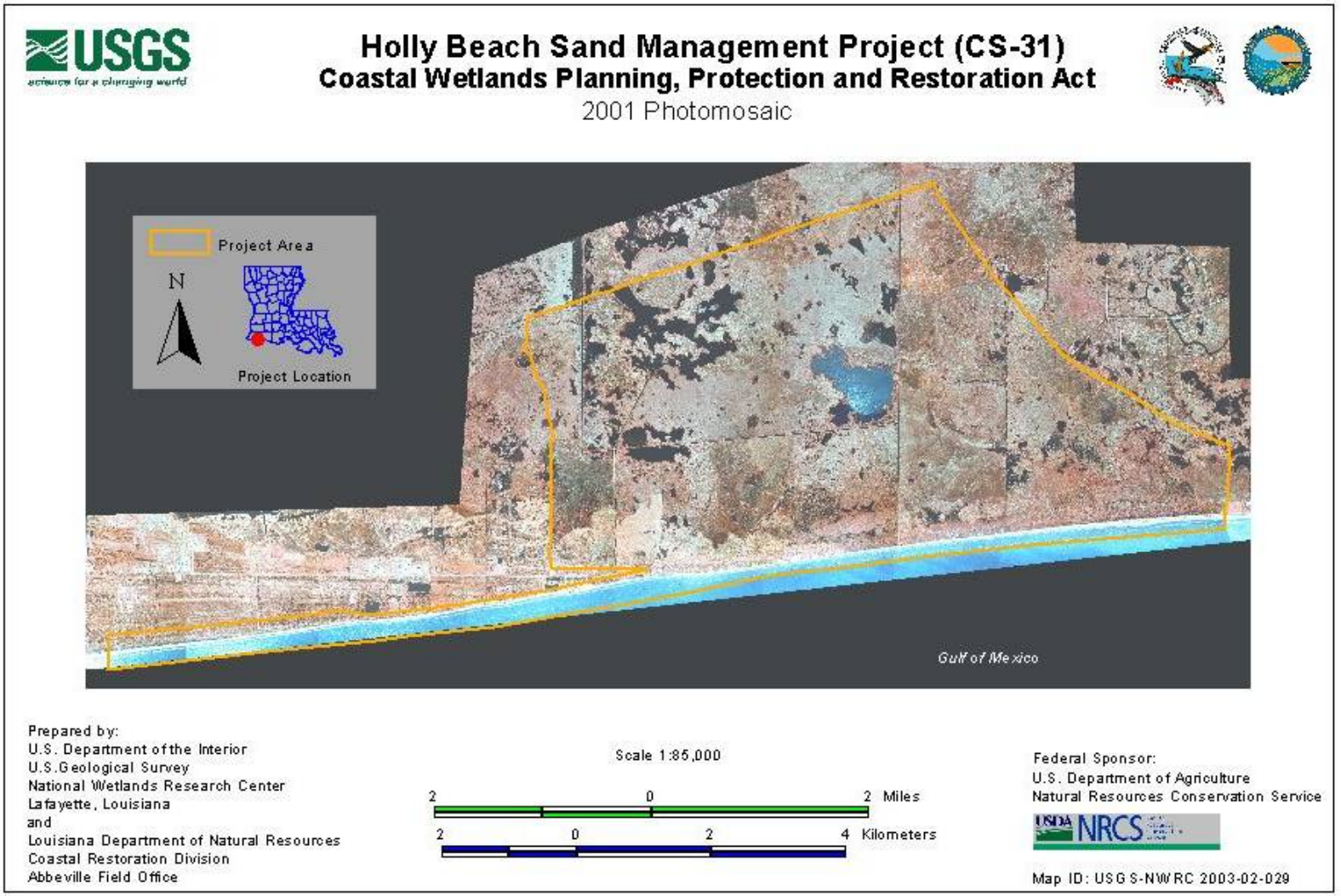

Figure 2. Photomosaic of the Holly Beach Sand Management (CS-31) project area from photography obtained November 17, 2001.

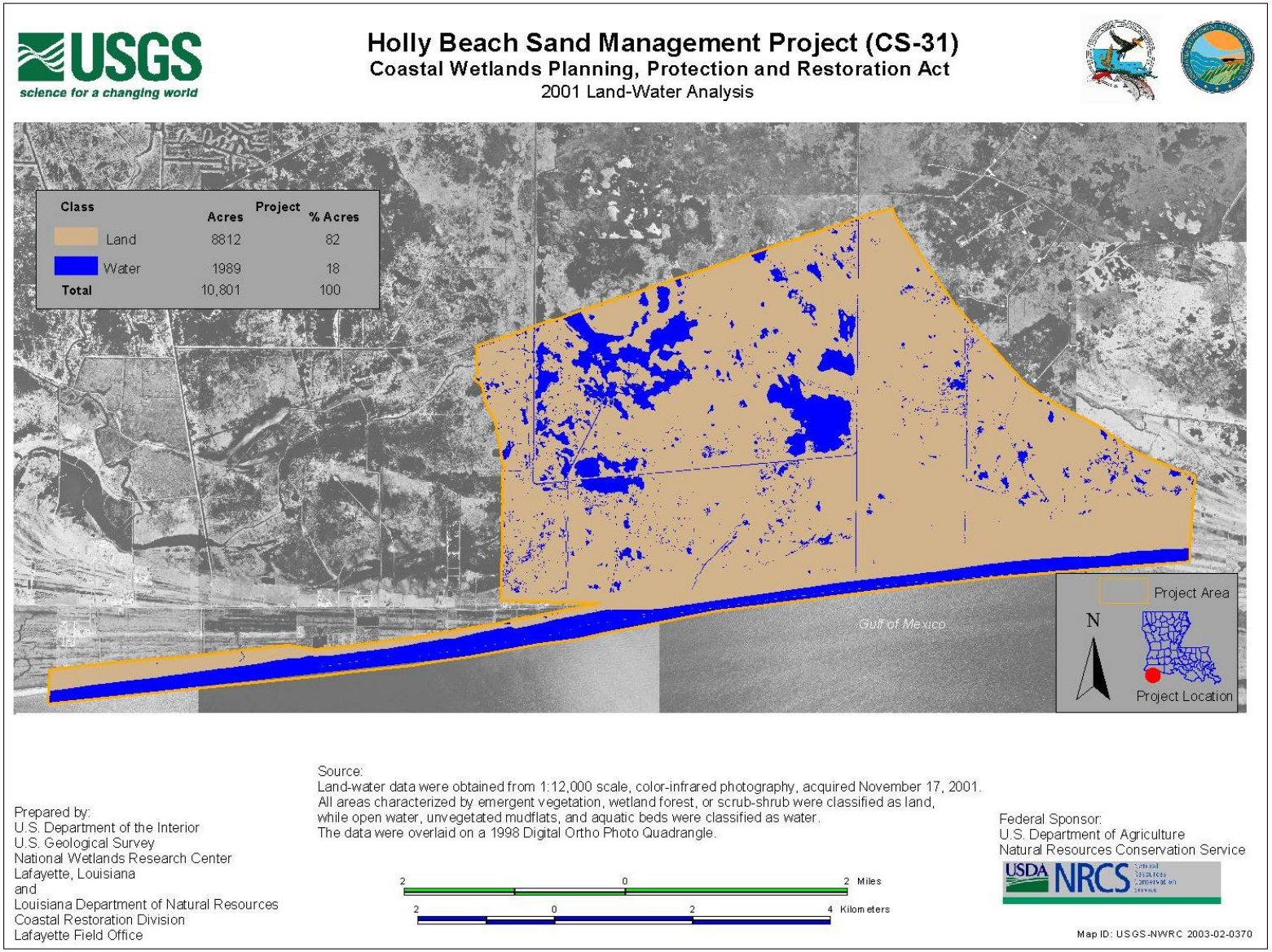

Figure 3. Land/Water analysis of the Holly Beach Sand Management (CS-31) project area from photography obtained November 17, 2001.

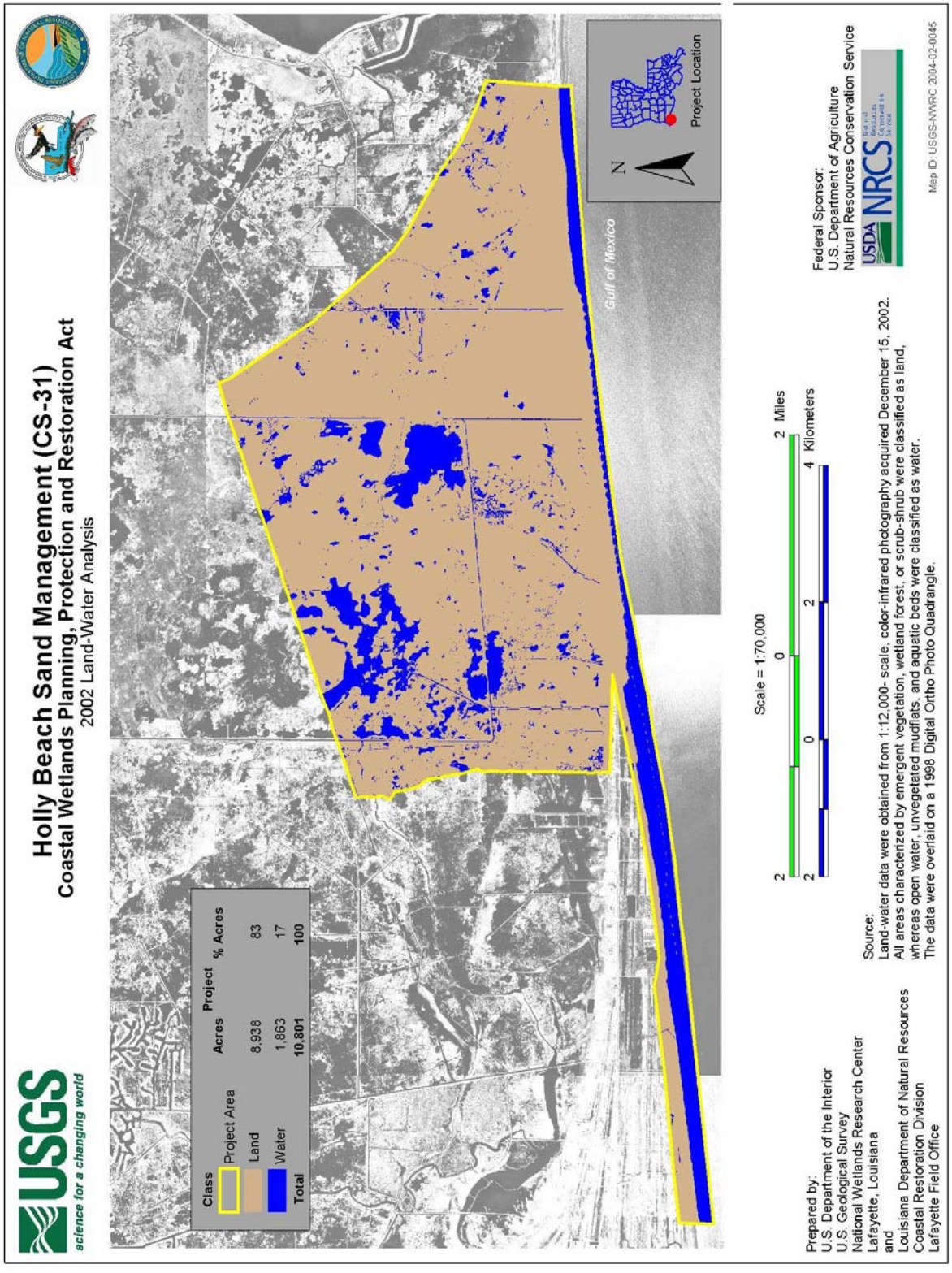

Figure 4. Land/Water analysis of the Holly Beach Sand Management (CS-31) project area from photography obtained December 15, 2002.

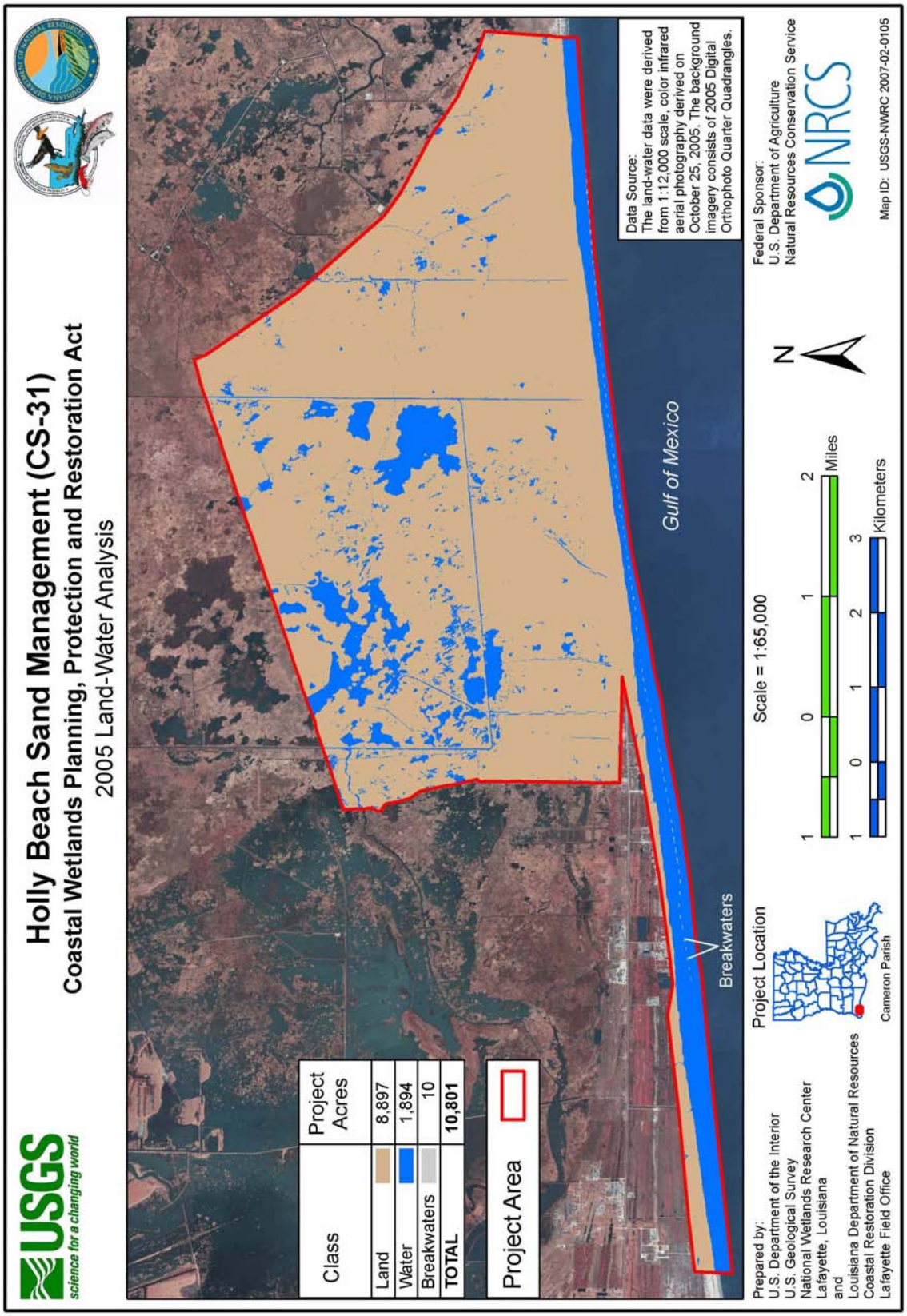

Figure 5. Land/Water analysis of the Holly Beach Sand Management (CS-31) project area from photography obtained October 25, 2005.

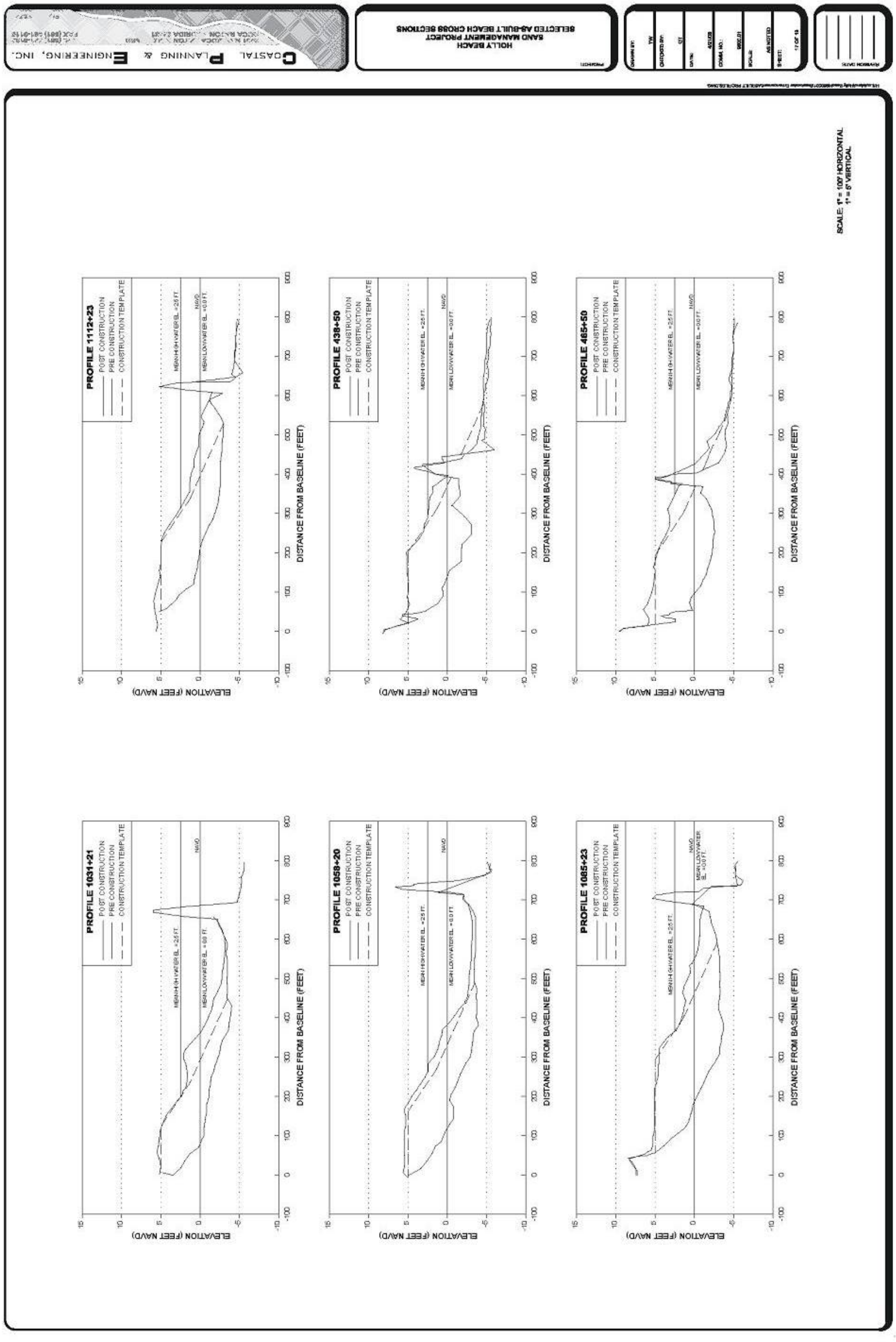

Figure 6a. Holly Beach sand management selected pre-construction and as-built cross-sections.

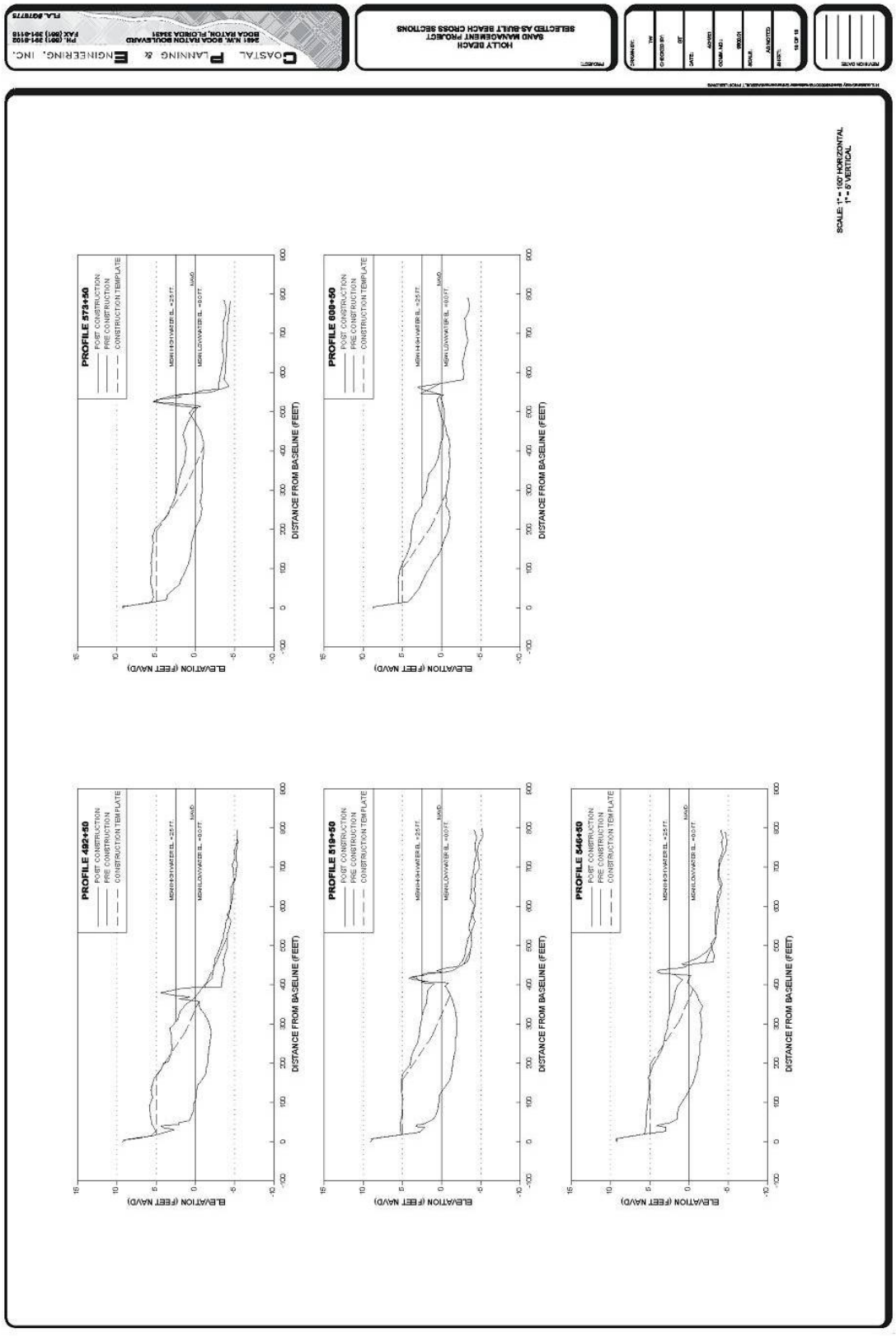

Figure 6b. Holly Beach sand management (CS-31) selected pre-construction and as-built cross-sections.

Figure 7a. View of the sand fencing and vegetation plantings at Station CS31-108 taken in April 2004. Note the dune formation almost covering the fences. The photograph is facing east.

Figure 7b. View of the sand fencing and vegetation plantings at Station CS31-150 taken in October 2004. The photograph is facing east.

Figure 7c. View of a section of the sand fencing and vegetation plantings taken October 2005. The photograph is facing west.

Holly Beach Sand Management (CS-31)
Vegetation Plantings

Table 1. Scientific and common names of other species observed during the 2002, 2003, and 2004 vegetation plantings survey.

Scientific Name	**Common Name**
Cakile geniculata	gulf searocket
Chrysopsis mariana	Maryland goldenaster
Pluchea odorata	sweetscent
Symphyotrichum subulatum	eastern annual saltmarsh aster
Spartina patens	marshhay cordgrass
Solidago sempervirens	seaside goldenrod
Amaranthus rudis	tall amaranth
Amaranthus australis	southern amaranth
Eclipta prostrata	false daisy
Alternanthera philoxeroides	alligatorweed
Ipomoea pes-caprae	bayhops
Vigna luteola	hairypod cowpea
Cyperus odoratus	fragrant flatsedge
Ipomoea imperati	beach morningglory

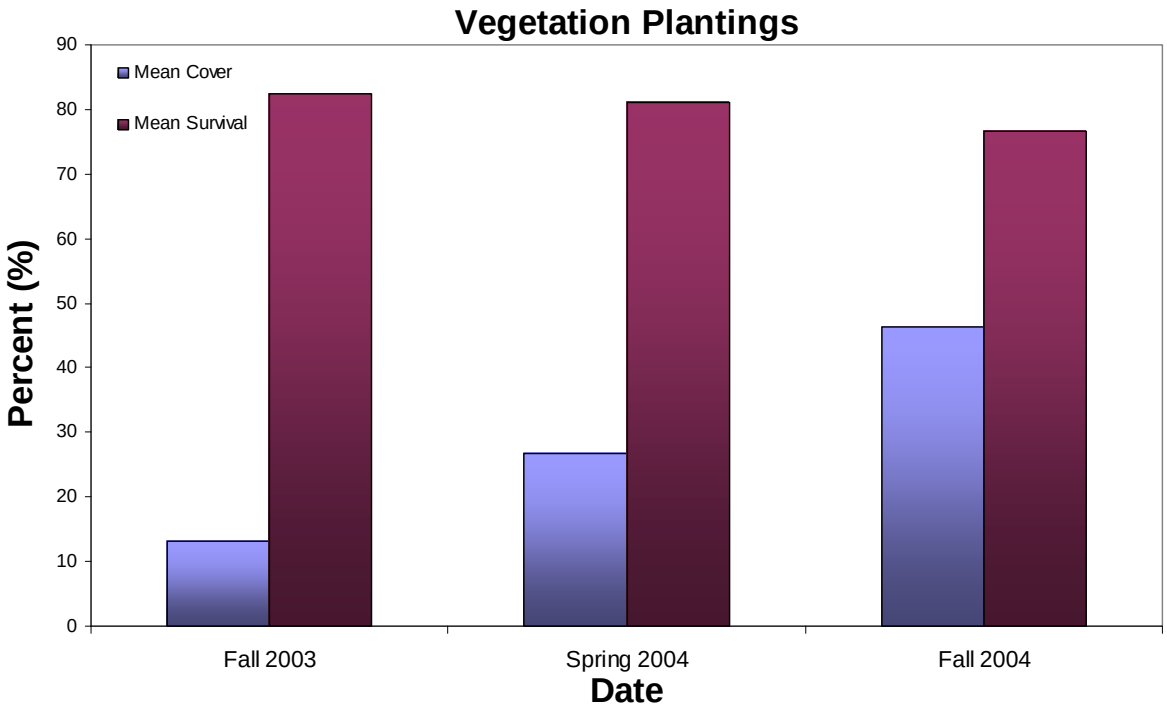

Figure 8. Mean percent cover and survival of the *Panicum amarum* plantings on the 2003 and 2004 surveys.

Holly Beach Sand Management (CS-31)
Shoreline Change

Table 2. Tide levels during shoreline surveys. Data were collected at Sabine Pass in ft Mean Sea Level.

Date of Survey	Tide level (Ft MSL)
Spring 2003	0.51
Fall 2003	0.47
Spring 2004	0.18
Fall 2004	-0.17
Spring 2005	0.17
Fall 2005	-0.89
Spring 2006	0.77

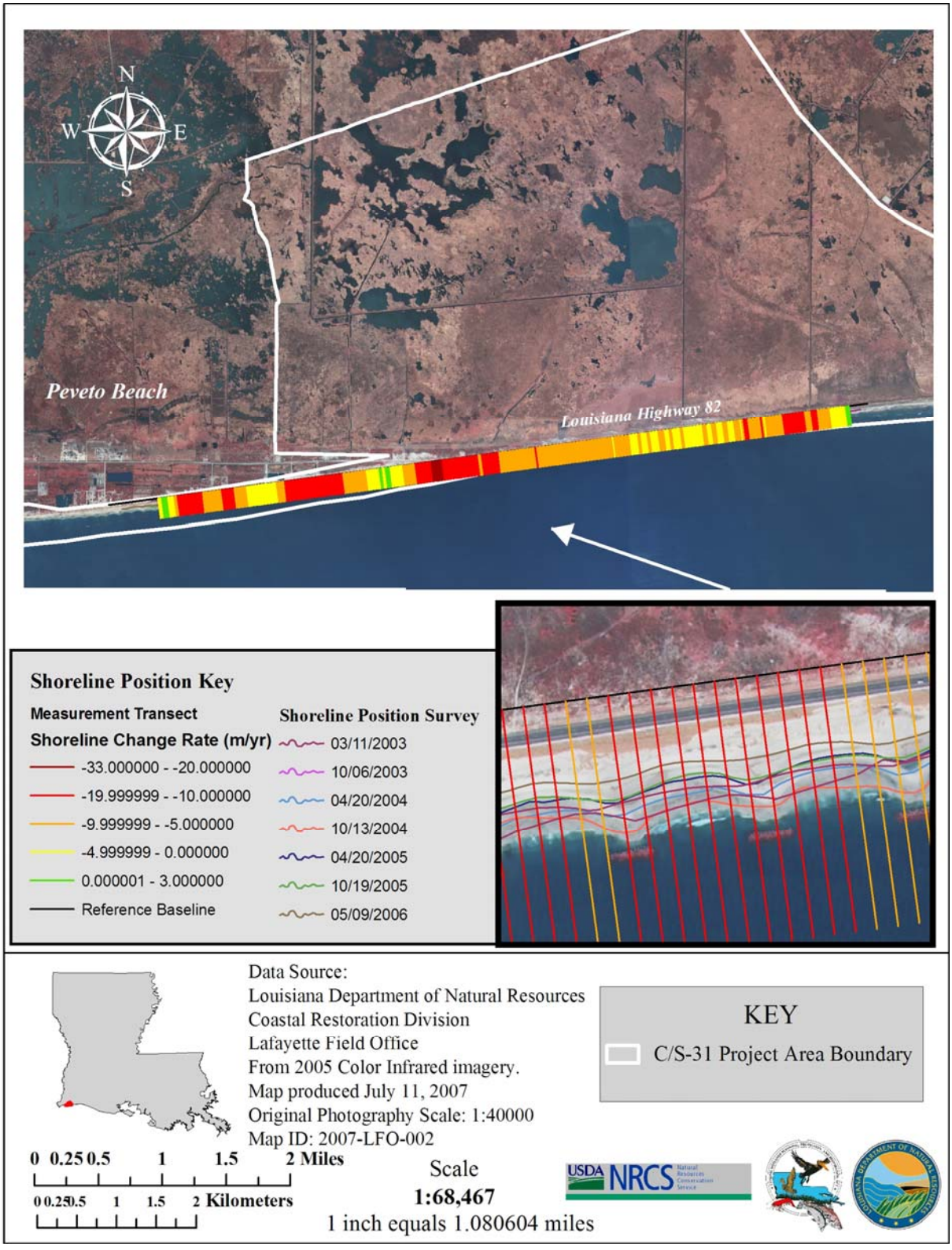

Figure 9. Shoreline change rates across all surveys from spring 2003 to spring 2006.

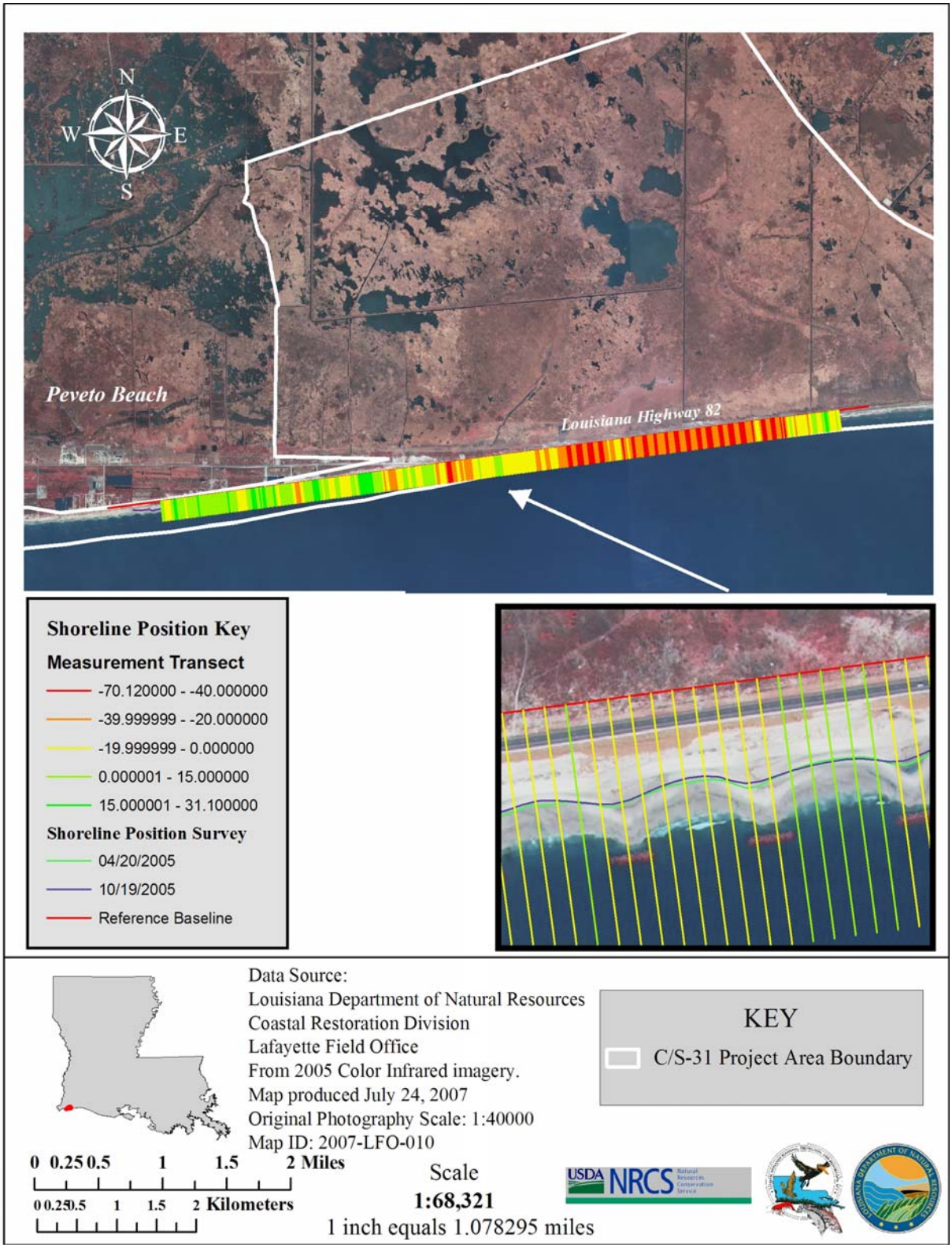

Figure 10. Shoreline change rates comparing pre- and post-Hurricane Rita surveys.

Figure 11. Location of continuous recorder stations at the Holly Beach Sand Management (CS-31) project.

Holly Beach Sand Management (CS-31)

Salinity Data

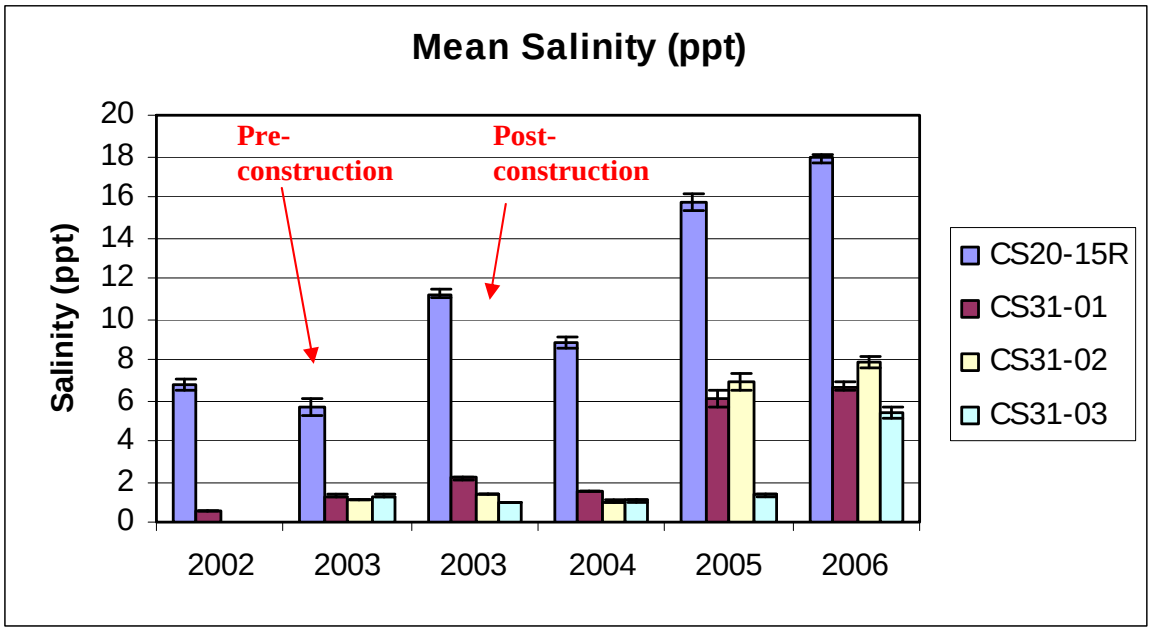

Figure 12. Yearly salinity means at all CS-31 project area stations and CS20-15R for years 2002-2006.

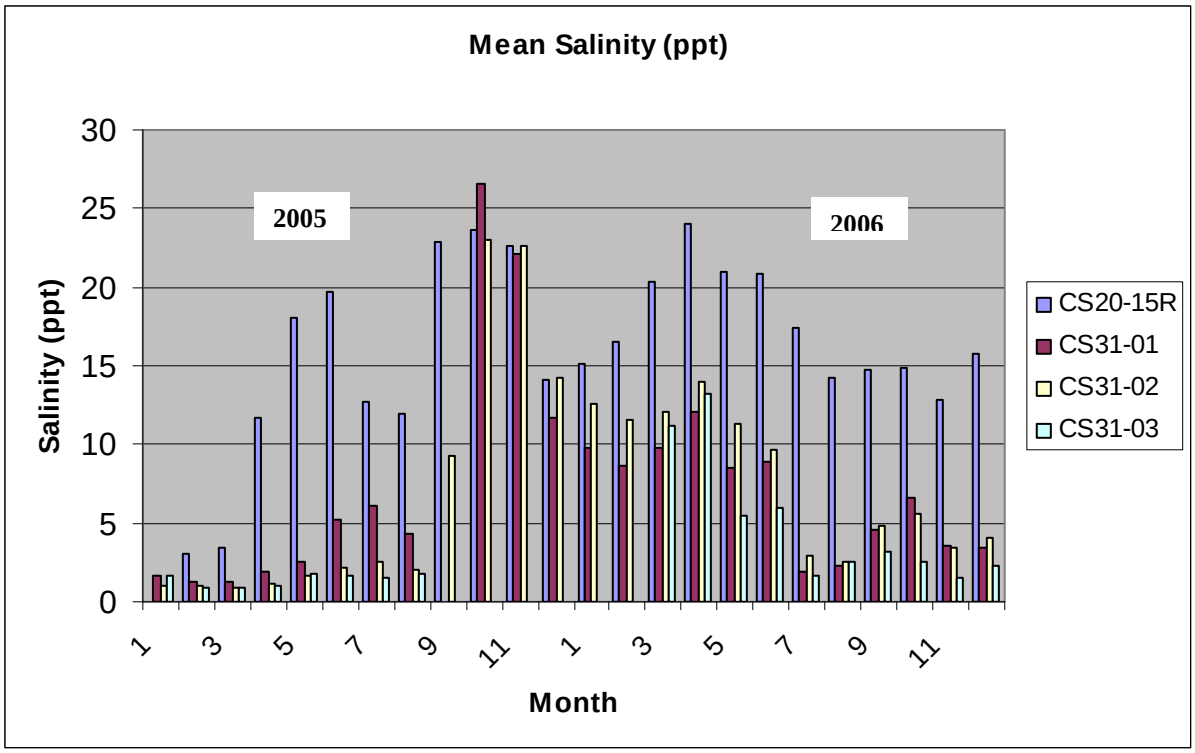

Figure 13. Monthly means at CS-31 project area stations and CS20-05R for years 2005 and 2006.

Holly Beach Sand Management (CS-31)
Emergent Vegetation

Table 3. Scientific and common names of plant species observed during the 2002, 2003, 2004, 2005, and 2006 vegetation surveys of the CS-31 project area.

Scientific Name	Common Name
Amaranthus australis	southern amaranth
Baccharis halimifolia	eastern baccharis
Borrichia frutescens	bushy seaoxeye
Cyperus odoratus	fragrant flatsedge
Distichlis spicata	seashore saltgrass
Echinochloa walteri	coast cockspur
Eclipta prostrata	false daisy
Iva annua	annual marshelder
Iva frutescens	bigleaf sumpweed
Mikania scandens	climbing hempvine
Paspalum vaginatum	seashore paspalum
Pluchea camphorata	camphor pluchea
Salicornia bigelovii	dwarf saltwort
Schoenoplectus americanus	chairmaker's bulrush
Schoenoplectus californicus	California bulrush
Schoenoplectus maritimus	cosmopolitan bulrush
Schoenoplectus pungens	common threesquare
Schoenoplectus tabernaemontani	softstem bulrush
Sesbania herbacea	bigpod sesbania
Solidago sempervirens	seaside goldenrod
Spartina patens	saltmeadow cordgrass
Suaeda linearis	annual seepweed
Symphyotrichum tenuifolium	perennial saltmarsh aster
Typha	cattail
Vigna luteola	hairypod cowpea

Holly Beach Sand Management (CS-31)
Emergent Vegetation

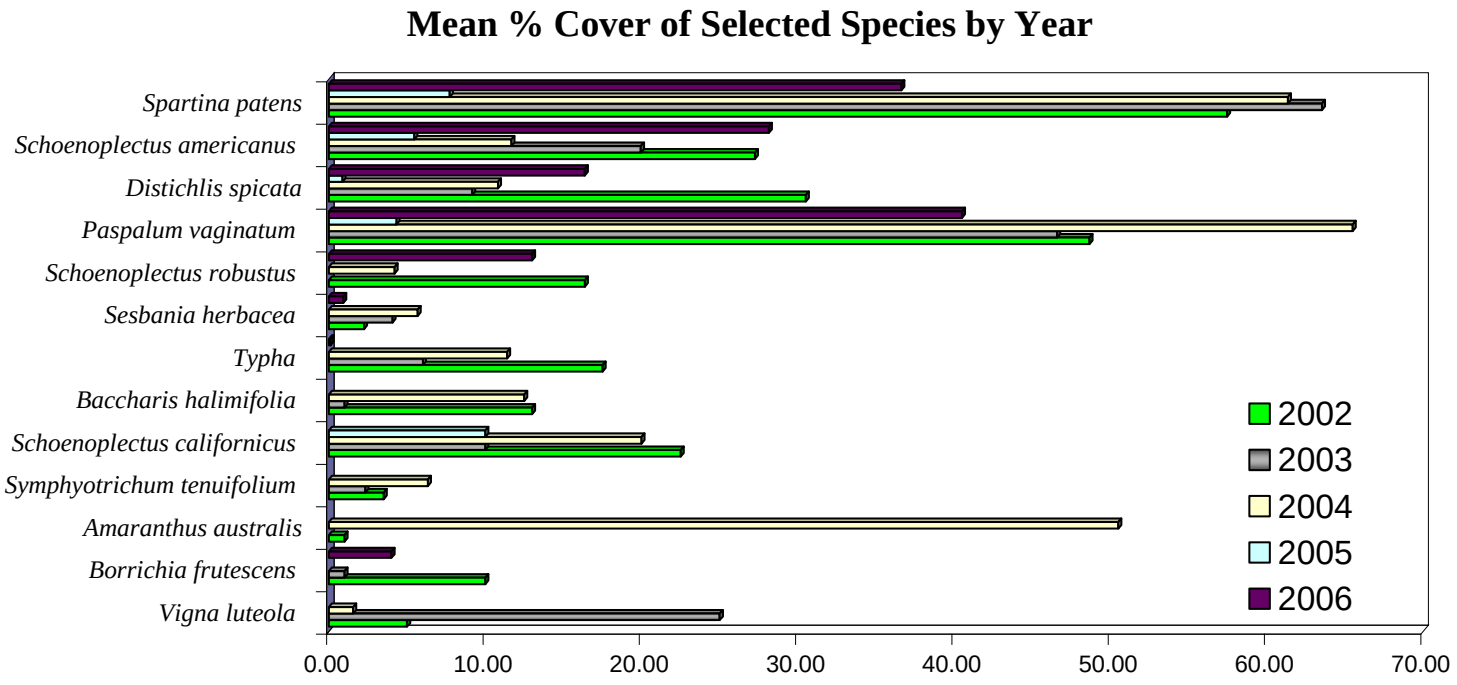

Figure 14 Mean % cover of selected species across all 4 m^2 plots within the CS-31 project area during October 2002, 2003, 2004, 2005, and 2006. Vegetation was sampled using the Braun Blanquet method.

Holly Beach Sand Management (CS-31)
Emergent Vegetation

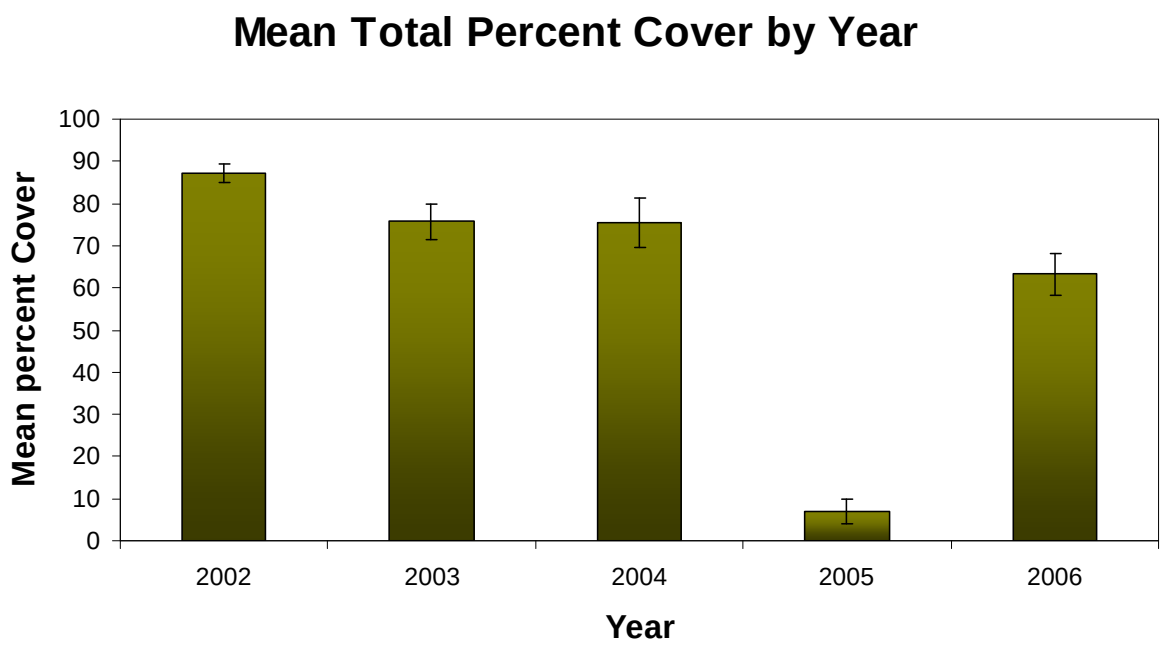

Figure 15. Percent cover of emergent vegetation in the Holly Beach project area during October 2002, 2003, 2004, 2005, and 2006. Vegetation was sampled using the Braun Blanquet method.

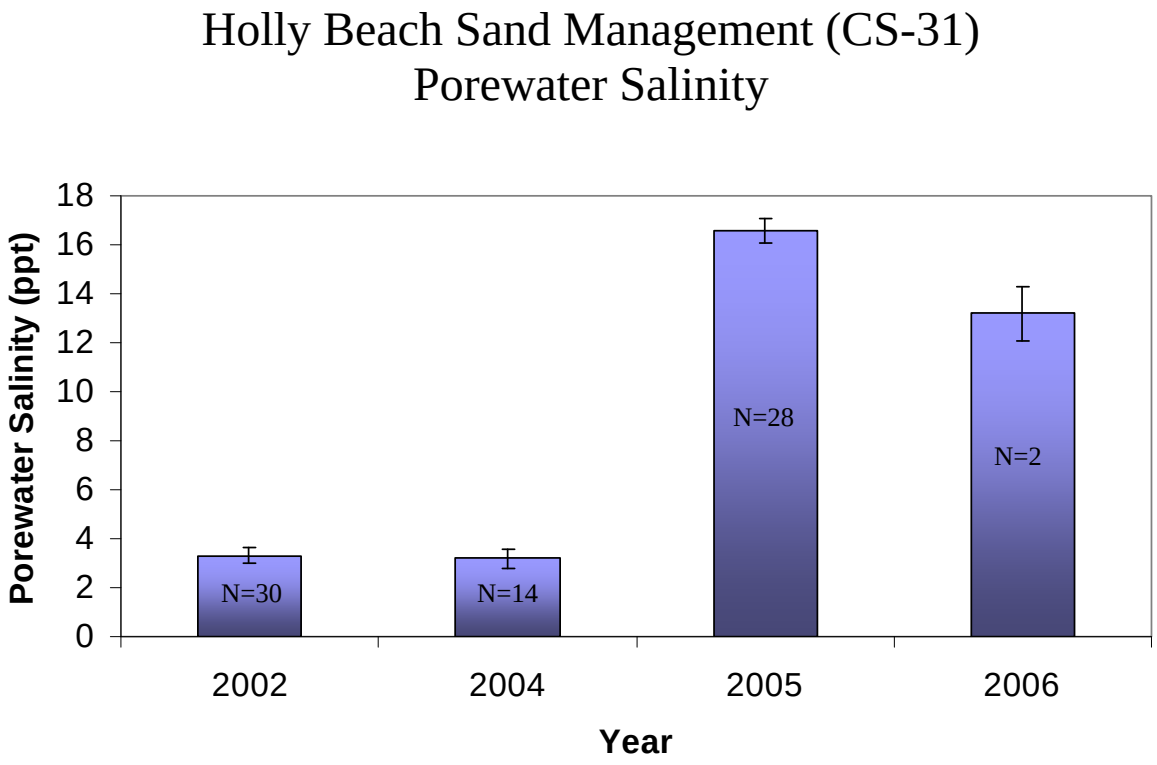

Figure 16. Porewater salinities collected at emergent vegetation stations on 2002, 2004, 2005, and 2006 surveys.

POST-HURRICANE RITA EMERGENT VEGETATION:

In the CS-21 project area, 23 stations were randomly chosen from the available stations. In the last sampling before Rita (2002), the vegetation was only slightly stressed (figure 17). In 2005, 100% of the stations were stressed. By 2006 the stations had recovered to pre-storm stress levels (Refer to Appendix A for stress classifications). Total cover and species richness were lower in 2005 and had recovered to pre-storm levels by 2006 (figures 18 and 19). The species assemblages basically remained the same through all samples (figure 20).

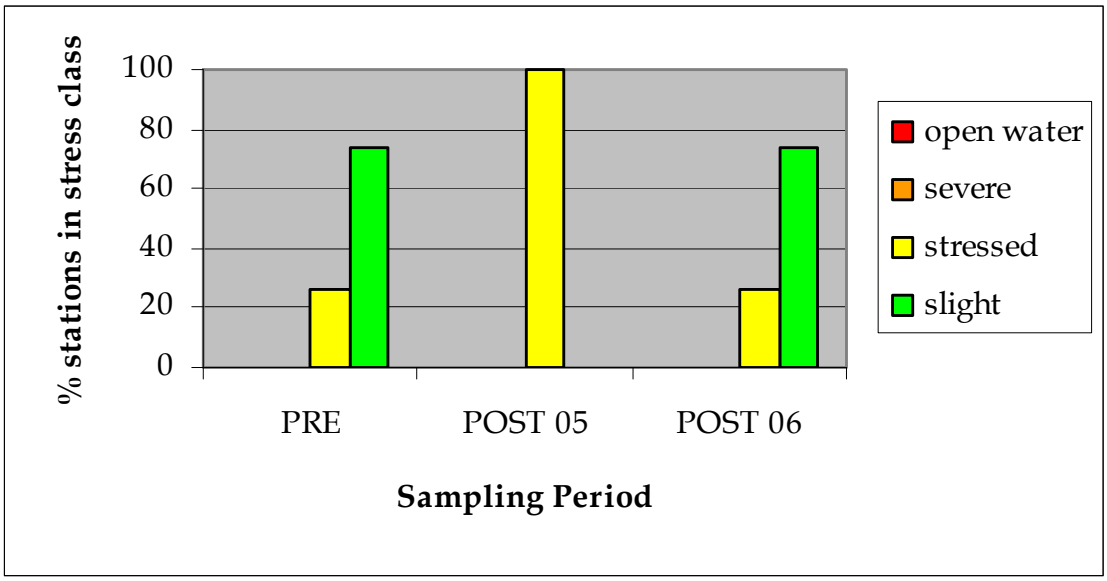

Figure 17. Percent of CS-31 vegetation stations in each stress class before and after Hurricane Rita (n=23).

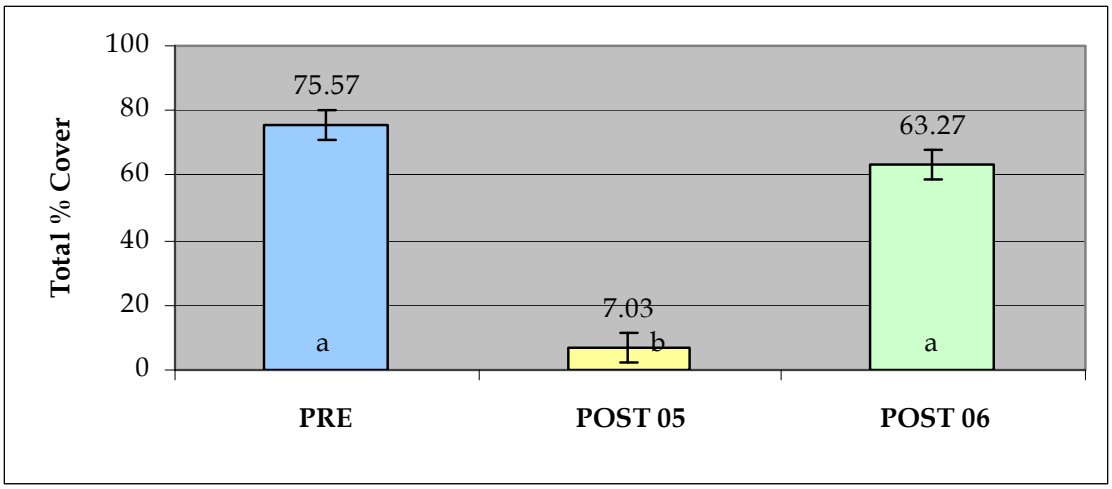

Figure 18. Total % Cover of vegetation at CS-31 pre- and post-Hurricane Rita.
LS Mean ± SE (n=23 stations). $F_{2, 68}$=59.53, p<0.0001. Levels connected by the same letter are not significantly different.

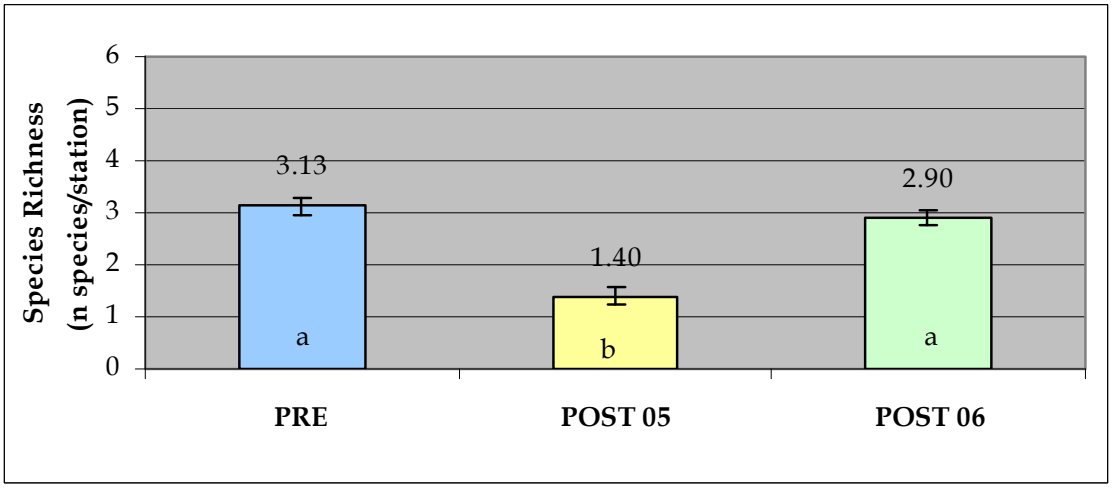

Figure 19. Species Richness at CS-31 pre- and post-Hurricane Rita. LS Mean ± SE (n=23 stations).). $F_{2, 68}$=35.33, p=0.0001. Levels connected by the same letter are not significantly different.

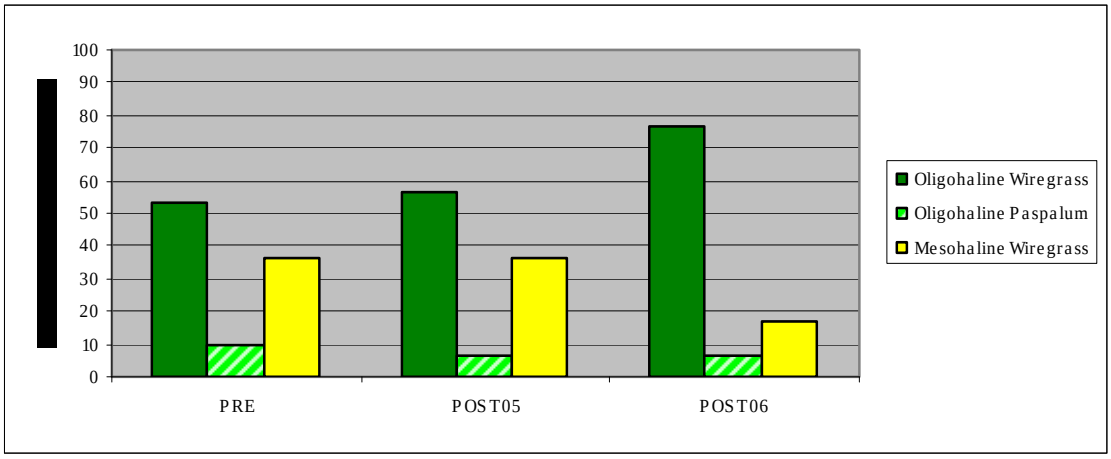

Figure 20. Percent of CS-31 vegetation stations in each Visser vegetation type before and after Hurricane Rita (n=23).

V. Conclusions

a. Project Effectiveness

The land to water analysis completed after Hurricane Rita showed 30 acres of land were lost within the project area during the storm, which occurred mostly along the shoreline.

Topographic/Bathymetric survey results indicated 21 ft/yr were lost along the shoreline between August 2005 and January 2006. Shoreline surveys completed by LDNR suggest a larger loss during this time period (46.33 ft/yr). However, these shoreline surveys didn't collect vertical data and thus were influenced by tide level differences. The difference between the pre-Rita and post-Rita tide levels was approximately one foot. The overall change rate for all shoreline surveys was -25.87 ft/yr. In their study of historical shoreline dynamics along Louisiana's Gulf of Mexico shoreline, Byrnes et al. (1995) found that average erosion rates for this area are -3.9 ft/yr with a maximum retreat rate of -8.2 ft/yr. The rates found by the Topo/Bathy surveys and the LDNR surveys are much greater. However, the Topo/Bathy surveys were only done immediately prior to and following Hurricane Rita. As mentioned above, the LDNR surveys didn't collect vertical data and thus are more useful in determining the changes occurring along the beach rather than an indication of actual loss rates.

The vegetation plantings were severely impacted by Hurricane Rita. They were replanted by the La. Dept of Agriculture and Forestry; no monitoring is scheduled for the new plantings.

Yearly mean salinity levels were maintained within the intermediate to brackish range and were below 3 ppt for the project area through 2004. Following Hurricane Rita, monthly mean salinity levels within the project area were higher than the brackish range until December 2005. From July to the end of 2006, monthly mean salinities remained below 7 ppt within the project area. The reference station, which is directly linked hydrologically to the Calcasieu Ship Channel, continued to experience monthly mean salinity levels near 15 ppt even once project area salinities returned to normal.

Total percent cover of emergent vegetation was high in the surveys preceding the storm (87% and 76%). Following Hurricane Rita, the cover dropped to 7% but appeared to be recovering by the fall of 2006 (63%). The marsh vegetation also appears to be meeting the goal of remaining within the intermediate to brackish class.

Porewater salinities averaged around 3 ppt before Hurricane Rita. Following Hurricane Rita, these values spiked to 16.59 ppt and were still averaging 13.2 ppt in 2006.

The subset of stations from CS-31 sampled 1 month and 1 year after Hurricane Rita behaved similarly to the whole dataset for similar marsh types in southwestern Louisiana (Appendix A). Stations in the project were moderately stressed in 2005 and had nearly fully recovered by 2006. The Visser types that existed before Hurricane Rita remained in 2006.

b. Recommended Improvements

Overall, the Holly Beach Sand Management Project structural components are in good condition and functioning as designed. A Federal Emergency Management Agency (FEMA) Project Worksheet (PW) is currently being processed for the sand fencing replacement project. Final cost for the replacement of 46,239 linear feet of sand fence through a contract with Landscape Management Services, Inc was $218,473.50. Once a final PW is issued from FEMA, then a decision will be made regarding beach re-nourishment. The original sand source was depleted during the initial project and there are concerns in finding alternate sand sources within a reasonable distance to the project site. A post-construction site visit was conducted on May 24, 2007, and the sand fence is working to develop sand dunes in front of and behind the primary fence in most areas. Sand is accumulating and developing a plateau in some areas between the secondary and primary fence locations, where approximately one-half of the secondary fence is covered with sand. New vegetative plants have been installed by others adjacent to both the primary and secondary fence lines. A few sections of the secondary fence were damaged by trash and debris brought onshore by high water events. No other maintenance work is required at this time.

Consideration should be given to extending the secondary fence alignment (approximately 5,800 linear feet) farther eastward towards the beginning of the project to allow for additional sand accumulation parallel to Louisiana Highway 82.

Additional funding should also be considered for monitoring of the new vegetation plantings installed after Hurricane Rita.

c. Lessons Learned

Future monitoring efforts on similar projects should focus more on topographic/bathymetric surveys for shoreline monitoring. This would allow a more accurate determination of loss or gain in ft/yr.

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APPENDIX A
Response of Emergent Vegetation to Hurricane Rita

Appendix A
Response of Emergent Vegetation to Hurricane Rita

METHODS

In response to Hurricane Rita in 2005, 163 LDNR emergent vegetation stations were sampled in the late summer/early fall of 2005 and 2006. The stations represented a subset of the LDNR vegetation stations established on the Chenier Plain to monitor CWPPRA projects, including CS-20 (40 stations), CS-17 (24 stations), CS-31 (30 stations), CS-28 (18 stations), ME-04 (18 stations), and ME-11 (12 stations) (Figure 1).

After the 2005 data collection, the stations were classified according to the level of disturbance/stress they had experienced and the resulting vegetation response. Stations were classified as either Open Water, Severely Stressed, Moderately Stressed (also classified as "Stressed"), or Slightly Stressed (Table 1). Data collected in 2006 and the last CWPPRA data available from before Hurricane Rita were also classified by stress.

At each station, a marker had been previously established. A 2m x 2m square was placed on the marsh and Total % Cover, % Cover of each species present in the plot, and height of the dominant species were collected. Presence of other species that were not in the plot, depth of surface water, salinity, and sometimes porewater salinity were noted.

The compiled vegetation data from the three sampling periods were utilized to classify each site according to Visser's vegetation types of the Chenier Plain (Visser et al. 2000). The pre-storm

types were determined with photographs and Visser Type definitions. The stations were reclassified after the 2005 and 2006 sampling. Stations that did not fit into any Visser Type after the storm maintained their pre-storm types. If the dominant species shifted to an identifiable Visser Type, the station was reclassified.

The data were analyzed to determine the impact of the storm on Total % Cover and Species Richness at three levels; overall by year (all 163 stations), by CWPPRA restoration project (7 projects), and with Visser vegetation type (6 types).

Table 1. Vegetation Stress Classifications used in this survey.

Vegetation Classification	Description
Open Water	Vegetation has been ripped out. 100% of plot is open water.
Severely Stressed	>50% of plot is open water. Vegetation is weak.
Stressed	Perennial grasses and herbs are mostly dead (>50%) or >25% open water. Often dominated by annual shrubs.
Slightly Stressed	Perennial grasses are healthy and vigorous.

RESULTS

COASTWIDE

Prior to Hurricane Rita, most of the vegetation stations utilized for this survey were healthy and intact (>80%). Following the hurricane in 2005, most of the stations were stressed (67%) or worse (20%). A year later in 2006, over 50% of the stations were back to pre-storm stress levels. Severely stressed stations either converted to open water or recovered to a less stressed state. Most stations that had been converted to open water in 2005 did not recover (Figures 1 and 2).

ANOVA was utilized to test for differences in Total % Cover (% of plot covered by living vegetation) and Species Richness (n species per plot) over the three sampling periods, by CWPPRA Project, and with Visser Vegetation Type classifications.

Total % Cover was significantly different over time (Figure 3). Post-ANOVA comparisons (Tukey's HSD) revealed that all three sampling periods were significantly different meaning Total % Cover for 2006 is still significantly lower than Pre-Rita levels. Species Richness was also significantly different over the three sampling periods (Figure 4). The number of species present before Rita and in 2006 were statistically the same.

Most of the projects had significant differences over time for both Total % Cover and Species Richness with trends similar to the overall model (Figures 3 and 4). Post-ANOVA comparisons were utilized to determine whether the projects had recovered to pre-storm levels for both Cover and Richness (Table 2).

Visser Type was added to the overall model and the interaction between Visser Type and time was analyzed. Both models had significant differences in Visser Type over time (Figures 5 and 6). Post-ANOVA contrasts of Cover and Richness Pre-Rita and Post 06 for each Visser Type revealed that all Visser Types were the same in Total Cover (had recovered to pre-storm levels) and in Richness except Fresh Bulltongue (mostly in the ME-04 project area), which had not

recovered and in Oligohaline Wiregrass, which had significantly more species per plot post-Rita than before (up from 2.83 to 3.22 species).

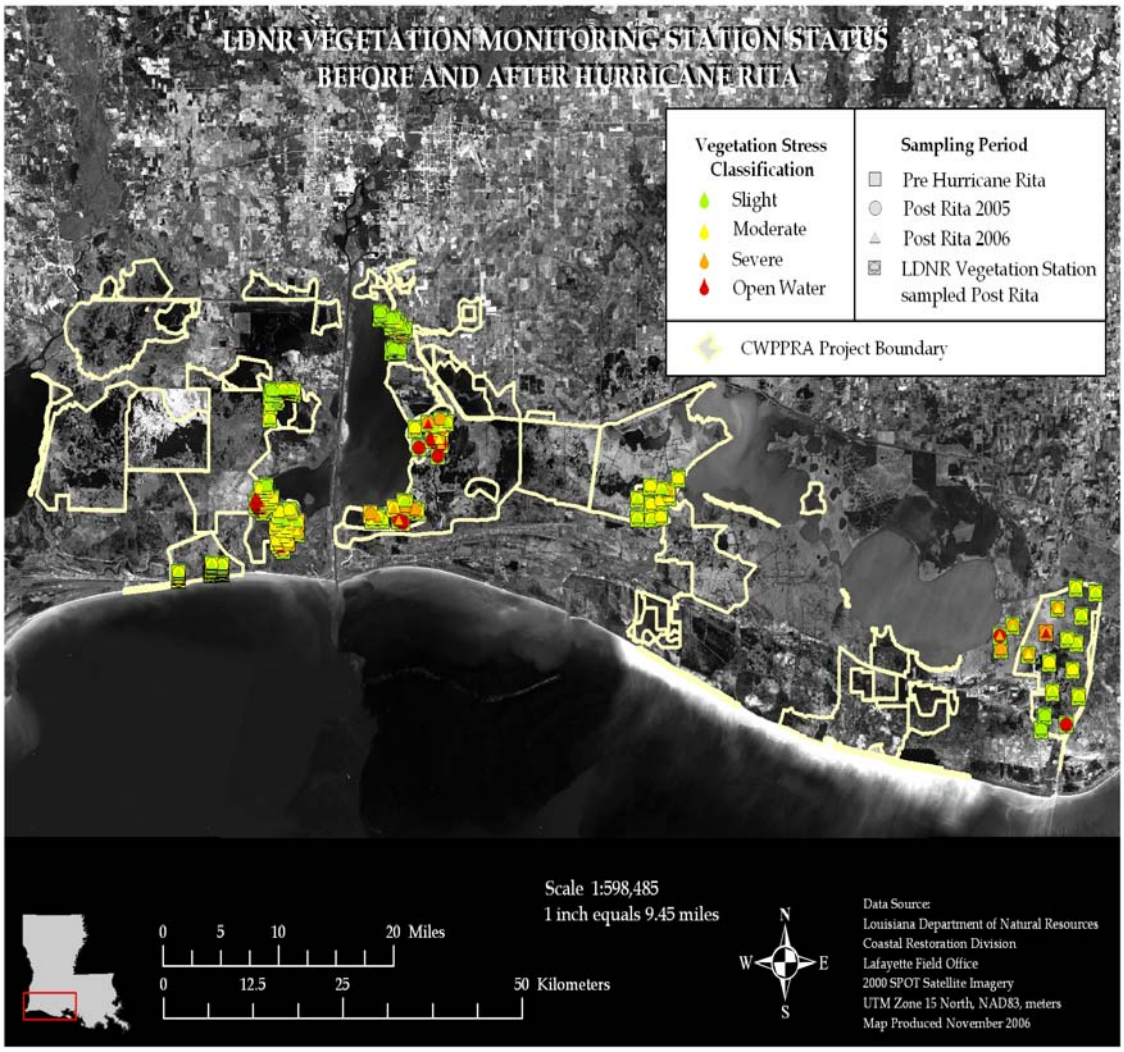

Figure 1. Location and status of LDNR vegetation stations sampled after Hurricane Rita. Stations were classified according to storm induced stress as described in Table 1.

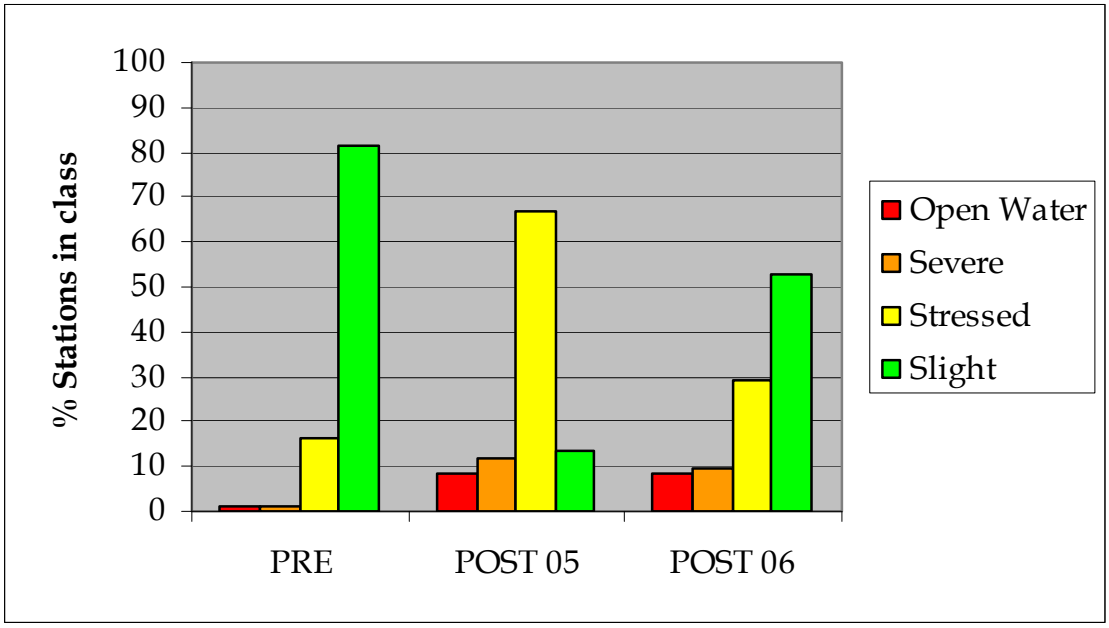

Figure 2. Percent of LDNR vegetation stations in each stress class before and after Hurricane Rita (n=163).

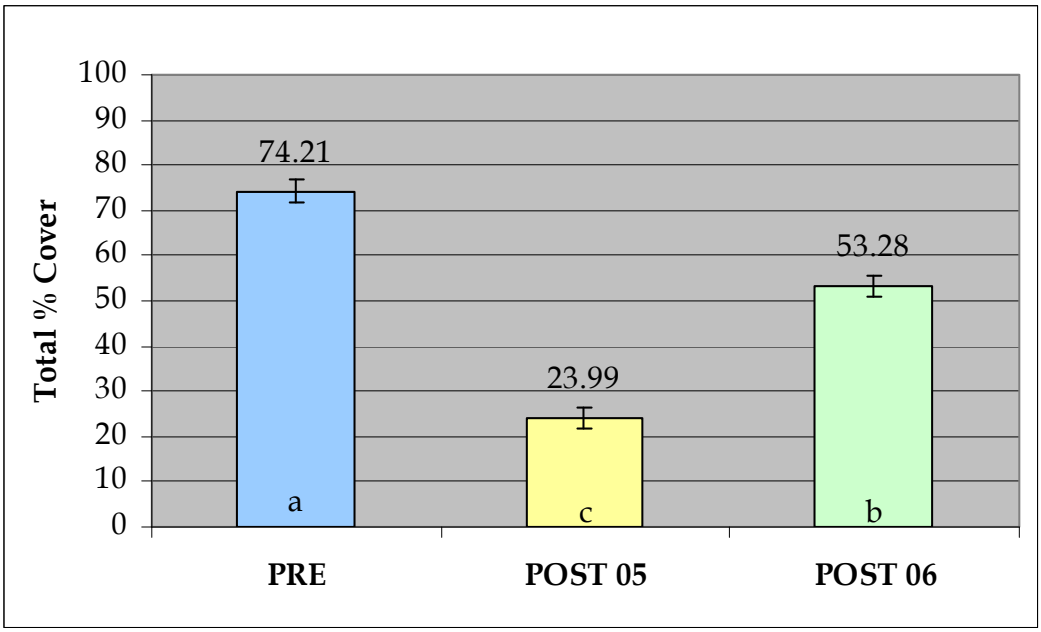

Figure 3. Total % Cover pre- and post-Hurricane Rita. LS Mean ± SE, n=163 stations, $F_{2, 488}$=109.7, p<0.0001. Levels not connected by same letter are significantly different.

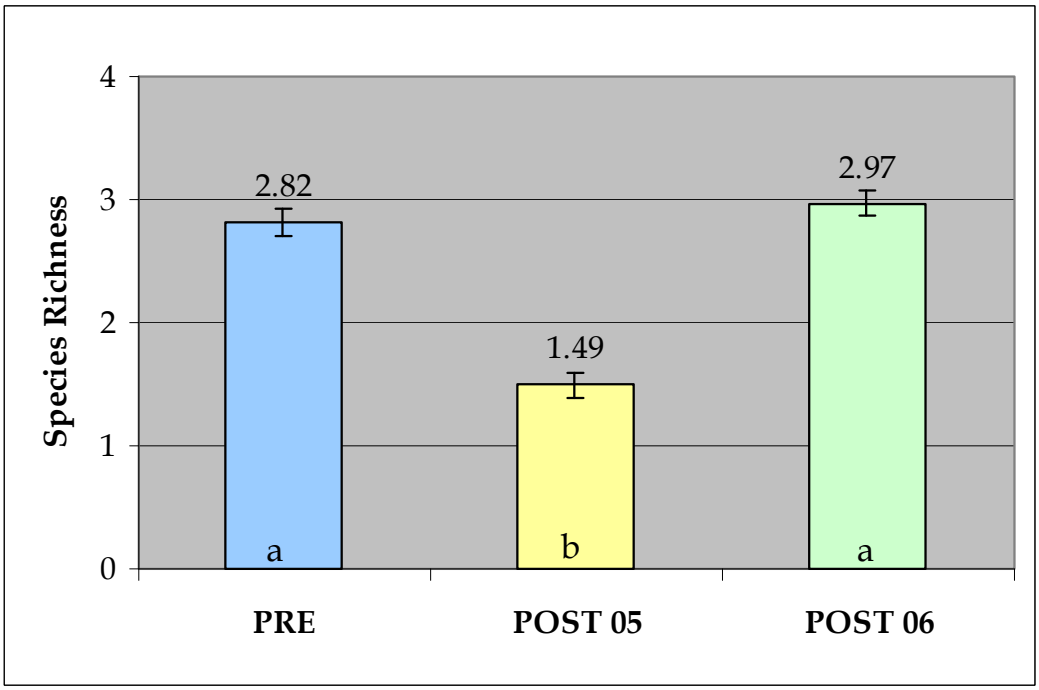

Figure 4. Species Richness pre- and post-Hurricane Rita. LS Mean ± SE, n=163 stations, $F_{2, 488}$=56.8, p<0.0001. Levels not connected by same letter are significantly different.

Table 2. CWPPRA Project ANOVA Results

Results of Post-ANOVA comparisons by CWPPRA Project Summary of 2006 levels relative to Pre-Hurricane Rita and 2005		
Project	**Total Cover**	**Species Richness***
CS-17	Not Recovered	Recovered
CS-20	Not Recovered	Recovered
CS-21	Recovered	Recovered
CS-28	Recovered	No Rita Impact.
CS-31	Not Recovered	Recovered
ME-04	Not Recovered	Recovered
ME-11	No Rita Impact	Recovered

*****Although the number of species present returned to Pre-Rita levels at most projects, many of the species present were disturbance species.

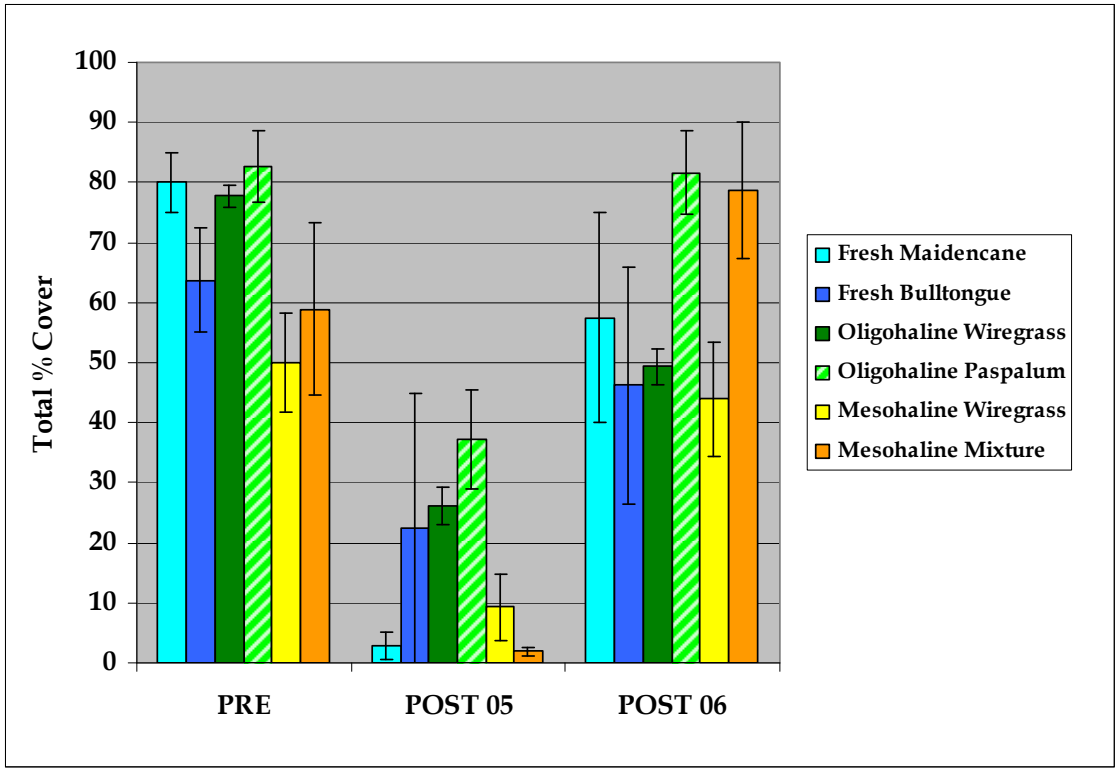

Figure 5. Total % Cover by Visser Vegetation Type. LS Mean ± SE, n=163 stations, $F_{17, 488}$=17.0, p<0.0001.

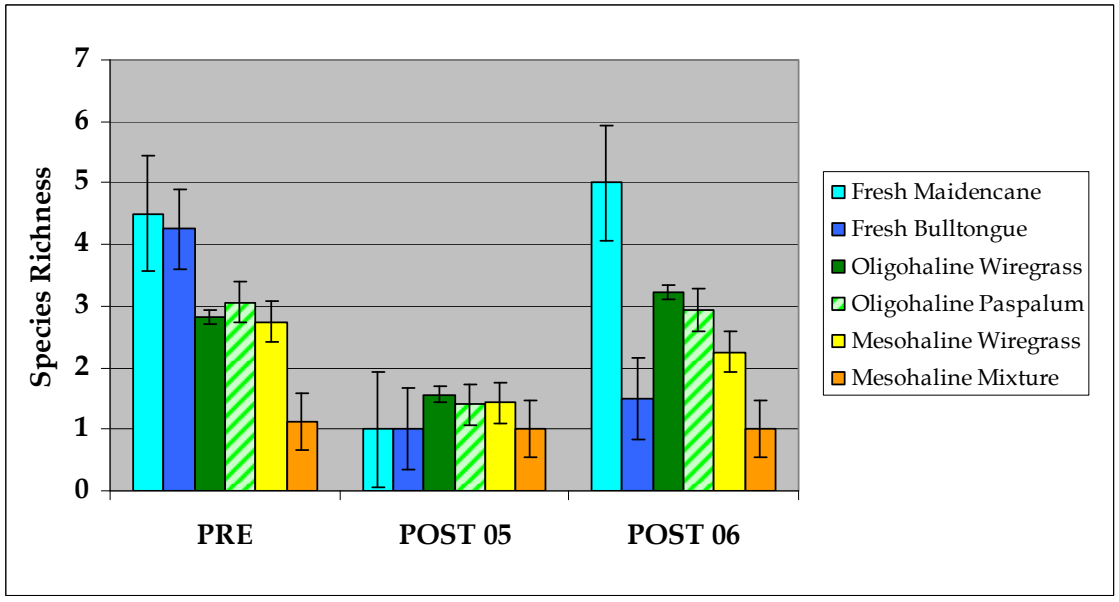

Figure 6. Species Richness by Visser Vegetation Type. LS Mean ± SE, n=163 stations, $F_{17, 488}$=10.9, p<0.0001.

LITERATURE CITED

Visser, J. M., R. H. Chabreck, and R. G. Linscombe. 2000. Marsh vegetation types of the Chenier Plain, Louisiana, USA. Estuaries 23(3) 318-327.

APPENDIX B
(Inspection Photographs)

Appendix B
(Inspection Photographs)

Photo 1, View of sand enhancement project, looking west beyond project limits. (10-30-2006)

Photo 2, Close up view of beach head with vegetative plants in background. (10-30-2006)

Photo 3, View of fence posts installed along primary fence alignment. (10-30-2006)

Photo 4, Start of new fence installation, east end of project. (10-30-2006)

Photo 5, View of primary and secondary fence alignments, looking west. (12-1-2006)

APPENDIX C
(Three Year Budget Projection)

Appendix C
(Three Year Budget Projection)

HOLLY BEACH SAND MANAGEMENT/ CS-31 / PPL 11

Three-Year Operations & Maintenance Budgets 07/01/2007 - 06/30/10

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Pat Landry	*Herb Juneau*	*NRCS*	*Herb Juneau*

	2007/2008	2008/2009	2009/2010
Maintenance Inspection	$ 5,407.00	$ 5,570.00	$ 5,737.00
Structure Operation			
Administration			$ -
Maintenance/Rehabilitation			

07/08 Description:

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

08/09 Description:

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

09/10 Description:

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

	2007/2008	2008/2009	2009/2010
Total O&M Budgets	**$ 5,407.00**	**$ 5,570.00**	**$ 5,737.00**

O &M Budget (3 yr Total)	**$ 16,714.00**
Unexpended O & M Budget	**$ 236,744.99**
Remaining O & M Budget (Projected)	**$ 220,030.99**

OPERATION AND MAINTENANCE BUDGET 07/01/2007-06/30/2008

HOLLY BEACH SAND MANAGEMENT/CS-31/PPL11

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$5,407.00	**$5,407.00**
General Structure Maintenance	LUMP	1	$0.00	**$0.00**
Engineering and Design	LUMP	1	$0.00	**$0.00**
Operations Contract	LUMP	1	$0.00	**$0.00**
Construction Oversight	LUMP	1	$0.00	**$0.00**
ADMINISTRATION				
LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSER 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	
	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
Navagation 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	1	$0.00	$0.00
Materials		LUMP	1	$0.00	$0.00
Mob / Demob		LUMP	1	$0.00	$0.00
Contingency		LUMP	1	$0.00	$0.00
General Structure Maintenance		LUMP	1	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$5,407.00**

OPERATION AND MAINTENANCE BUDGET 07/01/2008-06/30/2009

HOLLY BEACH SAND MANAGEMENT/CS-31/PPL11

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$5,570.00	**$5,570.00**
General Structure Maintenance	LUMP	1	$0.00	**$0.00**
Engineering and Design	LUMP	1	$0.00	**$0.00**
Operations Contract	LUMP	1	$0.00	**$0.00**
Construction Oversight	LUMP	1	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSER 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	
	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
Navagation 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	1	$0.00	$0.00
Materials		LUMP	1	$0.00	$0.00
Mob / Demob		LUMP	1	$0.00	$0.00
Contingency		LUMP	1	$0.00	$0.00
General Structure Maintenance		LUMP	1	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$5,570.00**

OPERATION AND MAINTENANCE BUDGET 07/01/2009-06/30/2010

HOLLY BEACH SAND MANAGEMENT/CS-31/PPL11

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$5,737.00	**$5,737.00**
General Structure Maintenance	LUMP	1	$0.00	**$0.00**
Engineering and Design	LUMP	1	$0.00	**$0.00**
Operations Contract	LUMP	1	$0.00	**$0.00**
Construction Oversight	LUMP	1	$0.00	**$0.00**
ADMINISTRATION				
LDNR / CRD Admin.	LUMP	1	$0.00	$0.00
FEDERAL SPONSER Admin.	LUMP	1	$0.00	$0.00
SURVEY Admin.	LUMP	1	$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	
	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
Navagation 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	1	$0.00	$0.00
Materials		LUMP	1	$0.00	$0.00
Mob / Demob		LUMP	1	$0.00	$0.00
Contingency		LUMP	1	$0.00	$0.00
General Structure Maintenance		LUMP	1	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$5,737.00**

APPENDIX D
(Field Inspection Notes)

Appendix D
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: CS-31 Holly Beach

Date of Inspection: October 30, 2006 Time: 10:30 am

Structure No.

Inspector(s): Stan Aucoin, Herb Juneau, Pat Landry, Darrell Pontiff (LDNR), Dale Garber (NRCS)

Structure Description: Sand fencing

Type of Inspection: Annual

Weather Conditions:sunny & cool

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				
Sand Fencing	Good			3,4, & 5	Fencing is being completely replaced from Hurricane RITA damage. Work completed on November 27, 2006.
Signage /Supports	N/A				
Sand (fill)	N/A				
Earthen Embankment	N/A				

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