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Department of Natural Resources
Coastal Restoration Division and
Coastal Engineering Division

2007 Operations, Maintenance, and Monitoring Report

for

Humble Canal Hydrologic Restoration

State Project Number ME-11
Priority Project List 8

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Cameron Parish

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I. Introduction

The Humble Canal Hydrologic Restoration project area encompasses 4,030 acres (1,228 ha) of fresh marsh in Cameron Parish, Louisiana (figure 1). The project area boundary is defined by Little Chenier Ridge to the south, the Mermentau River to the east, and oilfield canals to the north and west.

The marsh is classified as fresh marsh with 74 % of the project area marsh and 26 % of the project area open water, based on the Louisiana Department of Natural Resources (LDNR) GIS data for 1988-1990. Dominant emergent vegetation in the project area includes *Spartina patens* (marsh-hay cordgrass), *Typha latifolia* (cattail), and *Sagittaria lancifolia* (bulltongue). Dominant submerged aquatic vegetation (SAV) in the project area includes *Najas guadalupensis* (southern naiad), *Alga* sp., and *Chara* sp. (muskgrass) (U.S. Department of Agriculture, Natural Resources Conservation Service [USDA/NRCS] 2000).

Soils found in the project area include Allemands muck, Clovelly muck, Larose muck, Bancker muck, Aquents frequently flooded, Peveto fine sand, Hackberry loamy fine sand, and Hackberry-Mermentau complex (USDA/Soil Conservation Service [SCS] 1995). Most of the soils within the project area are classified as muck and are associated with brackish or freshwater marsh. The Aquents frequently flooded are hydraulically excavated soils that occur along the Mermentau River. The Peveto, Hackberry, and Hackberry-Mermentau are on the Little Ridge that comprises the southern boundary of the project.

Land loss data indicate that, from 1932 to 1990, approximately 826 acres (334 ha) of land were converted to open water in the Humble Canal project area (Dunbar et al. 1990). Land alteration, including the construction of Humble Canal in the 1950's and dredging of the Mermentau River to facilitate greater commercial use, has resulted in excessive water levels in some areas and saltwater intrusion from the south and east.

To aid in the removal of excess water without permitting saline water into the project area, five 48-inch culverts with variable crest weir inlets and flap gated outlets were constructed in an oilfield access canal north of Marseillais Bayou. Construction began in September 2002 and ended with implementation in March 2003.

Hurricane Rita struck the coast of southwestern Louisiana on September 24, 2005, with maximum storm surge of 8-9 ft (2.4 – 2.7 m) in the ME-11 project area. The U.S. Geological Survey (USGS) calculated the amount of land that changed to water resulting from the storm to be 98 square miles in southwestern Louisiana, with 62 square miles in the Mermentau basin (Barras 2006). This loss can be attributed to several patterns. Shearing, which is ripping and removal of marsh vegetation in historically healthy marshes, was observed in marshes bordering the east bank of Freshwater Bayou. The removal of remnant marsh from areas with historical land loss from the surge was observed due east of Pecan Island, south of Sweet Lake, and due east of Deep Lake.

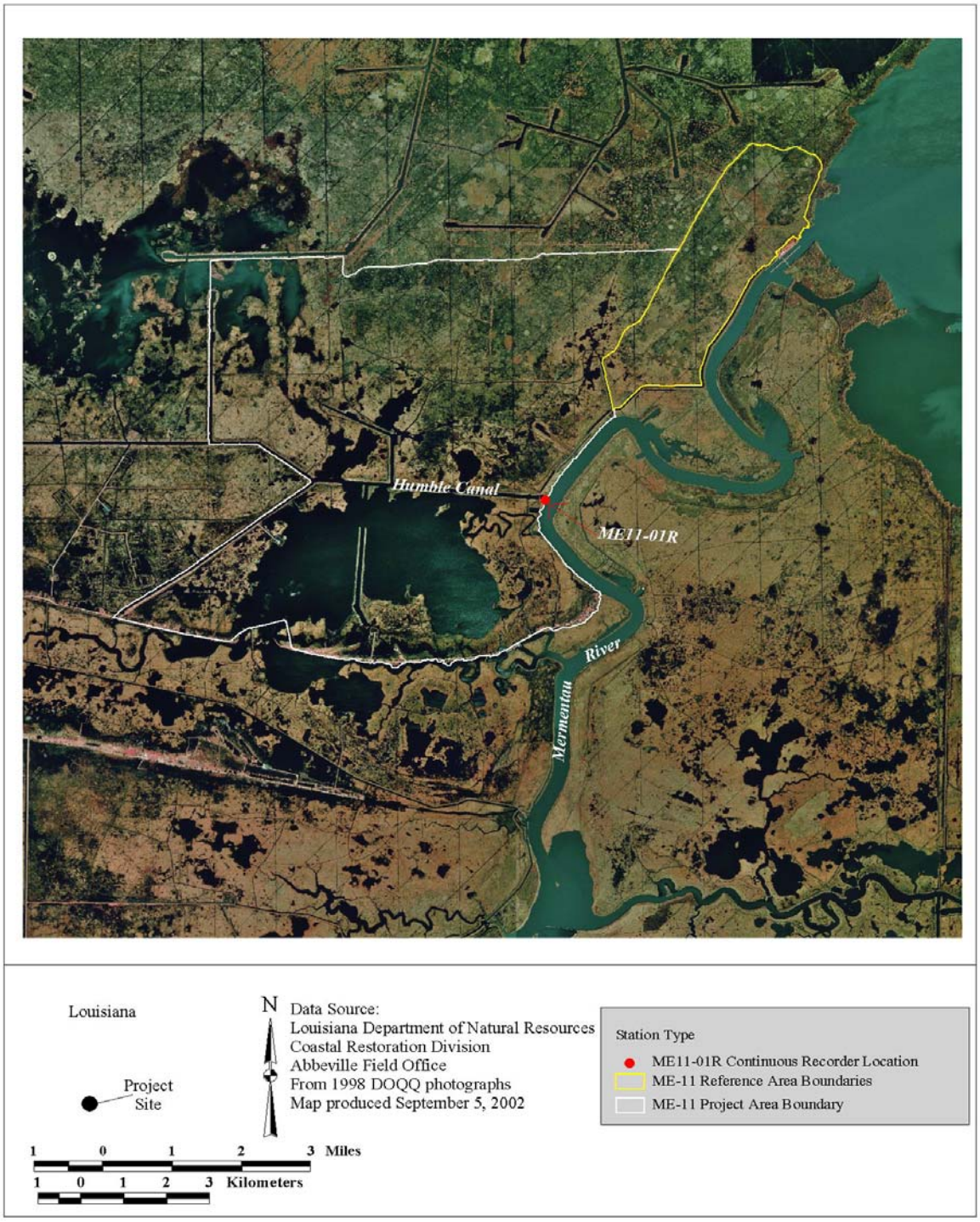

Figure 1. Humble Canal Hydrologic Restoration Project (ME-11); project and reference areas.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Humble Canal Hydrologic Restoration Project (ME-11) 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, 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 Humble Canal Hydrologic Restoration Project (ME-11) was held on December 4, 2006, under sunny skies and cold temperatures with a 10-15 mph North wind. In attendance were Mel Guidry and Darrell Pontiff from LDNR, along with Dale Garber representing the Natural Resources Conservation Service (NRCS), and Andre Aucoin and Donnie Saucier with Acadian Engineers, Inc. All parties met at the boat launch on the Mermentau River in Grand Chenier, and traveled north to the Humble Canal Project site. The annual inspection began at approximately 11:00 a.m. at the marine barrier on the juncture of the Humble Canal Project Outfall Channel and the Mermentau River.

The field inspection included a complete visual inspection of all project features. Staff gauge readings, where available, were used to determine approximate elevations of water, earthen embankments, water control structure, and other project features. Photographs were taken at each project feature (see Appendix B) and field inspection notes were completed in the field to record measurements and any notable deficiencies (see Appendix D).

b. Inspection Results

Marine Barrier Fence:

The structure is in excellent condition. Some shrinkage of the sign lettering has occurred and the signs are slightly bent from Hurricane Rita damage. Bank tie-ins, pile caps, hardware, etc. are in excellent condition. No maintenance is required at this time. (Photos: Appendix B, Photo 1)

Hyacinth Guard:

This feature is in good condition. There is a small amount of debris and wrack material clogging the hyacinth guard. Maintenance to remove the debris is needed. (Photos: Appendix B, Photo 2)

Water Control Structure:

Overall, the structure is in good post-construction condition. The inspection noted the erosion of the structure embankment behind each wing wall and over the structure identified in the 2005/2006 O& M Inspection. Miscellaneous structure maintenance such as replacement of bolts and flap gate locking arms will be required. The camp building identified in the 2005/2006 O & M Inspections has not been removed by the owner. (Photos: Appendix B, Photos 3, 4, 5, and 6)

II. Maintenance Activity (continued)

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

None at this time.

ii. Programmatic/ Routine Repairs

Repair structure hardware, clean wrack and debris, provide additional aggregate on top of structure.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since March 2003, the construction completion date of the Humble Canal Hydrologic Restoration Project (ME-11).

No maintenance has been performed on this project.

III. Operation Activity

a. Operation Plan

Operation, Maintenance, and Monitoring Plan

Funding of the Humble Canal project includes funds specifically dedicated for operation and maintenance. The La DNR will be responsible for the maintenance, monitoring, and replacement of project elements through the 20-year life of the project. Operation of the structure will be done by Miami Corporation without CWPPRA funding.

Structure Operational Scheme

18" diameter marine ingress structure with screwgate	< 6 ppt at structure	Screw gate open
	≥ 6 ppt at structure	Screw gate closed
Five 48" diameter water control structures with stoplogs and flap gates	1.2' NA VD88 (marsh elevation)	Flaps operating stoplogs adjusted to achieve water level at marsh elevation

Safety Factors:
1) If interior *Panicum hemitomon* marsh has salinity reading exceeding 2 ppt, the 6 ppt structure closing criteria will be adjusted downward accordingly to insure protection of the marsh resource.
2) If excessive water levels occur as a result of rainfall or other event, the stoplogs will be lowered as necessary to allow excess water to be removed until water level reaches 1.2' NA VD88 (marsh level).

b. Actual Operations

In accordance with the operation schedule outlined in the Operation and Maintenance Plan, the structure was operated as required, by Miami Corporation personnel at no cost to LDNR. At present, a servitude agreement amendment is being developed between Miami Corporation and LDNR for Miami Corporation to continue to operate the structure according to the permitted operational plan at no cost to LDNR. Post-Hurricane Rita, the Cameron Drainage District had to breach the levee to remove excess water.

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 ME-11 Monitoring Plan to merge it with CRMS-*Wetlands* and provide more useful information for large scale modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. There is one CRMS-*Wetlands* site in the ME-11 project area.

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 sites in the ME-11 project area (Appendix A). The project was slightly stressed by the storm and fully recovered by 2006.

a. Monitoring Goals

The objective of the Humble Canal Hydrologic Restoration Project is to improve removal of excess water without permitting saline water into the freshwater marsh of the project area.

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

1. Increase present (yr 2000) land to water ratio.

2. Maintain mean water levels in the project area between 6 in below and 2 in above marsh level.

3. Maintain mean monthly salinity (0–3 ppt) in the project area after construction and prevent salinities from exceeding 7 ppt.

4. Increase or maintain the occurrence and cover of fresh marsh vegetation species in the project area.

5. Increase frequency of occurrence of submerged aquatic vegetation (SAV) in the project area.

b. Monitoring Elements

Aerial Photography:

Near-vertical color-infrared aerial photography (1:12,000 scale) was used to measure land to open water rations and land change rates for the project and reference areas. The photography was obtained in 2000 prior to project construction and was obtained post-construction in 2005. Photography will be acquired again in 2017. The photography was checked for flight accuracy, color correctness, and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and geo-rectified by USGS/National Wetlands Research Center

(NWRC) personnel according to standard operating procedures (Steyer et al. 1995, revised 2000).

Water Level:

To monitor water levels, continuous recorders and staff gauges were deployed in the project area and in the Mermentau River (figure 2). The project area recorder was removed in April 2004 and the reference recorder (ME11-01R) was maintained. Data from CRMS0624 is available in the project area and nearby CRMS0605 will be used as a reference. Water level relative to marsh will be used to assess the proportion of time water levels were within the target range.

Station	Data collection period	Marsh Elevation (ft NAVD 88)
ME11-01R	5/1/2000 to 12/31/2006	2.33
ME11-02	5/1/2000 to 5/29/2001	2.33
ME11-72	5/29/2001 to 4/14/2004	2.28
CRMS0624-H01	11/9/2006 to 12/31/2006	1.38
CRMS0605-H01	3/23/2006 to 12/31/2006	1.13

Salinity:

Salinities were monitored monthly at permanent discrete sampling stations within the project area (figure 2) from 2000 to April 2004. Continuous data recorders were deployed to record salinity at one location in the project area and at one location in the Mermentau River. The project area recorder was removed in April 2004 and the reference recorder (ME11-01R) was maintained. Data from CRMS0624 is available in the project area and nearby CRMS0605 will be used as a reference. Salinity data is used to characterize the spatial variation in salinity throughout the project area, and to determine if project area salinity is being maintained within the target range.

Emergent Vegetation:

To document the condition of emergent vegetation in the project area over the duration of the project, vegetation was monitored at sampling stations (figure 3) established systematically in the project and reference area using a modified Braun-Blanquet sampling method as outlined in Steyer et al. (1995). Four north-south transects were established uniformly across the project area and sampling stations were established uniformly along each transect line to obtain an even distribution throughout the project area. Two north-south transects were delineated across reference area # 1 to establish the sampling stations. Percent cover, dominant plant height, and species composition were documented in 4 m^2 sampling plots marked with two corner poles to allow for revisiting the sites over time. Vegetation was evaluated at the sampling sites in the fall of 2000 (pre-construction) and in the fall of 2003 (post-construction). Future vegetation sampling will be conducted through CRMS-*Wetlands.*

SAV:

The effect of the project on SAV abundance was determined by comparing SAV abundance before and after project construction. Three permanent locations were sampled in the project

area, and at three reference locations outside the project area (figure 4). Data were collected at two transects in each pond, with a minimum of 20 stations per transect. Frequency is determined by methods described in Chabreck and Hoffpauir (1962) and Nyman and Chabreck (1995). When water clarity permitted, cover and species abundance were estimated visually on each transect. SAV was evaluated in the fall of 2000 (pre-construction) and in the fall of 2003 (post-construction). Based on the CRMS-*Wetlands* review, future SAV sampling was discontinued.

Additional CRMS Monitoring Elements:

Porewater Salinity: Each time data sondes are serviced (every 4 to 6 weeks), porewater salinity is measured at the CRMS site. Three measurements are recorded at both 10 and 30 cm deep.

Soils: Sediment cores are collected at each CRMS site during site establishment and as needed. Three cores are extracted and sectioned into six 4 cm increments that are processed by the Louisiana State University (LSU) Wetland Soils lab. Bulk Density, % Organic Matter, pH, soil moisture, and soil salinity are reported. These data can be used to describe CRMS sites and to assess soil-related goals.

Surface Elevation Change: Rod Surface Elevation Tables (RSET) are established at each CRMS site. RSETs consist of a survey benchmark rod driven to refusal through the marsh surface. The benchmark rod has an attachment that receives the RSET instrument, which is leveled in four directions twice a year. Thirty six measurements are recorded from the RSET each time the table is read and the difference between readings gives marsh elevation change (mm).

Vertical Accretion: Feldspar plots are established at each CRMS site to measure the rate of vertical accretion over the surface marker horizon. Three plots are established at the same time as initial measurements are taken on the RSET. Two to three feldspar plots are maintained at each CRMS site at all times.

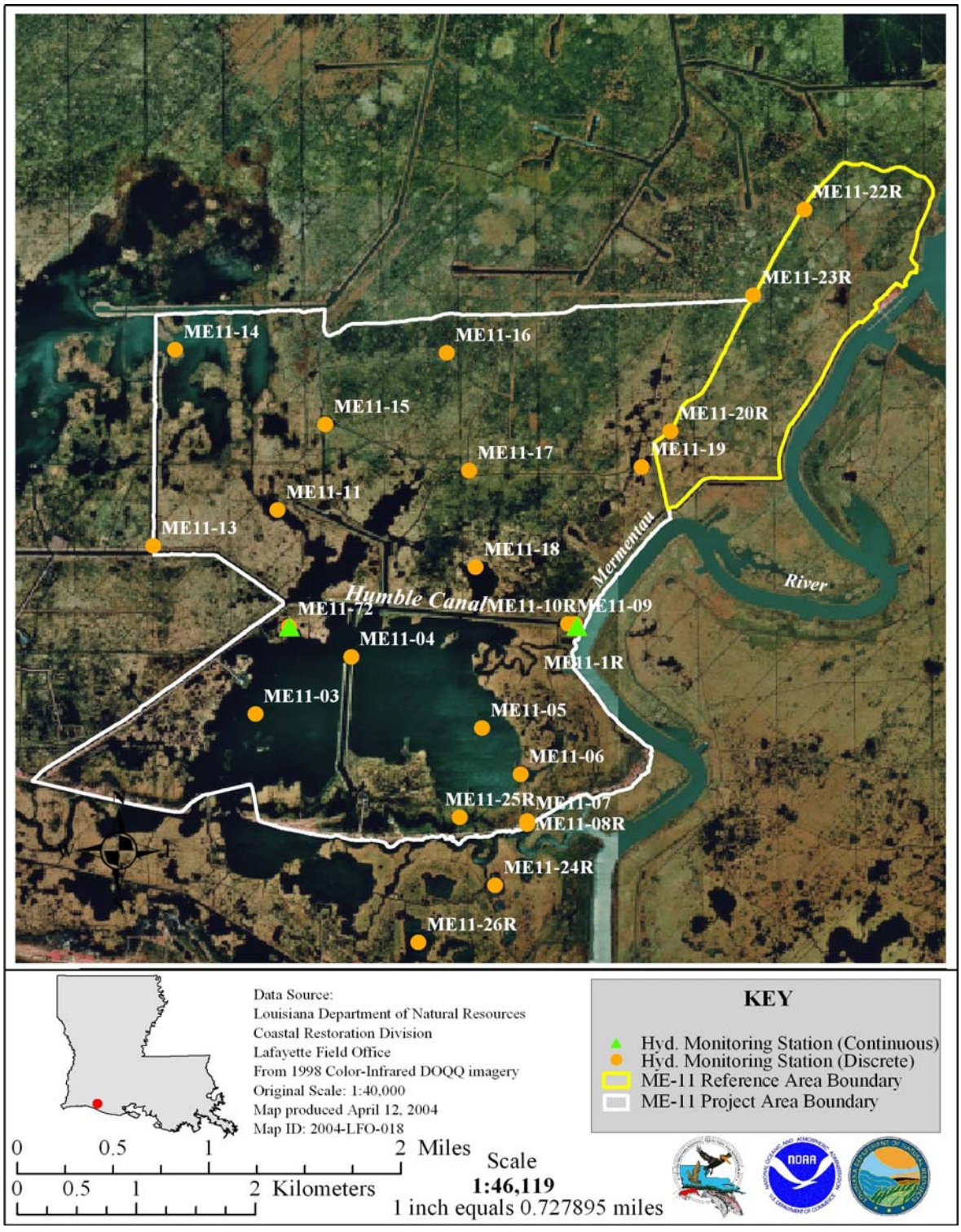

Figure 2. ME-11 project area with locations of continuous data recorders and discrete sampling stations.

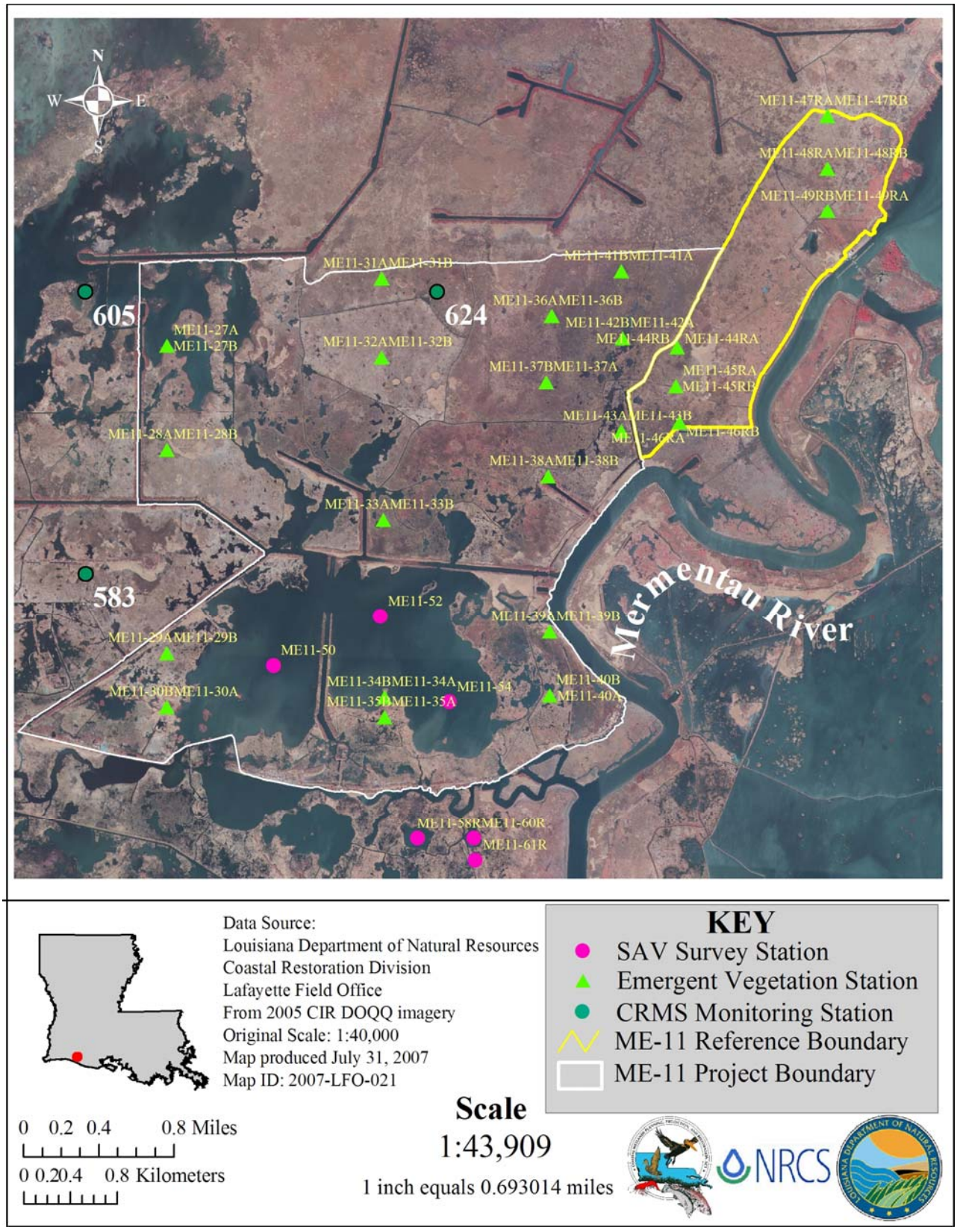

Figure 3. Location of emergent vegetation and SAV monitoring stations.

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

Aerial Photography:

Photography of the project and reference areas was obtained by USGS in 2000 and 2005 (figures 4 and 5). Comparisons of the photography indicate that the area is stable with approximately 68% of the project area and 98% of the reference area classified as land in both 2000 and 2005. The reference area lost two acres of land and the project area lost seven acres.

Water Level:

Water level data was available from five stations: two project area sondes (one replaced the other in 2001), one reference sonde in the Mermentau River (ME11-01R), and two CRMS stations, one in the project area (CRMS0624) and one near the project area that can serve as a reference (CRMS0605). Marsh elevations were known at all sites except ME11-01R, which was assumed to be the same as the project station (2.3 ft NAVD). The percentage of time water level was outside of the target range (> 2" below marsh surface and < 6" above) per day in the project area was compared to reference area pre- and post-construction using Chi-squared tests. In order to determine the interaction effect of project/reference area and time period, the difference between percent of time out of range per day (reference area – project area) was analyzed over time periods. Data collected during construction, from September 2002 to March 2003, was excluded.

Water levels were more than 6" above the marsh surface significantly more frequently in the project area than the reference area post-construction (figure 6). Pre-construction, both the project and reference area had relatively few deep flood events (< 10% of the time). Post-construction, the percent of time out of range increased in both areas but more so in the project area. In this regard, the project seems to have had the opposite effect desired.

Water levels were more than 2" below the marsh surface significantly less frequently in the project area than the reference area post-construction (figure 7). Pre-construction, the project area had water levels 2" below the marsh surface most of the time (over 80%). Post-construction, the frequency of those events was reduced to around 20%. The project appears to have had the desired impact on frequency of drying events.

It should be noted that the pre-construction period was six months in 2000 (May through October), which was during an extreme drought. It is not surprising that water levels were rarely > 6" above the marsh and were often > 2" below the marsh pre-construction (figure 8). It is difficult to definitively assess project effectiveness under these conditions.

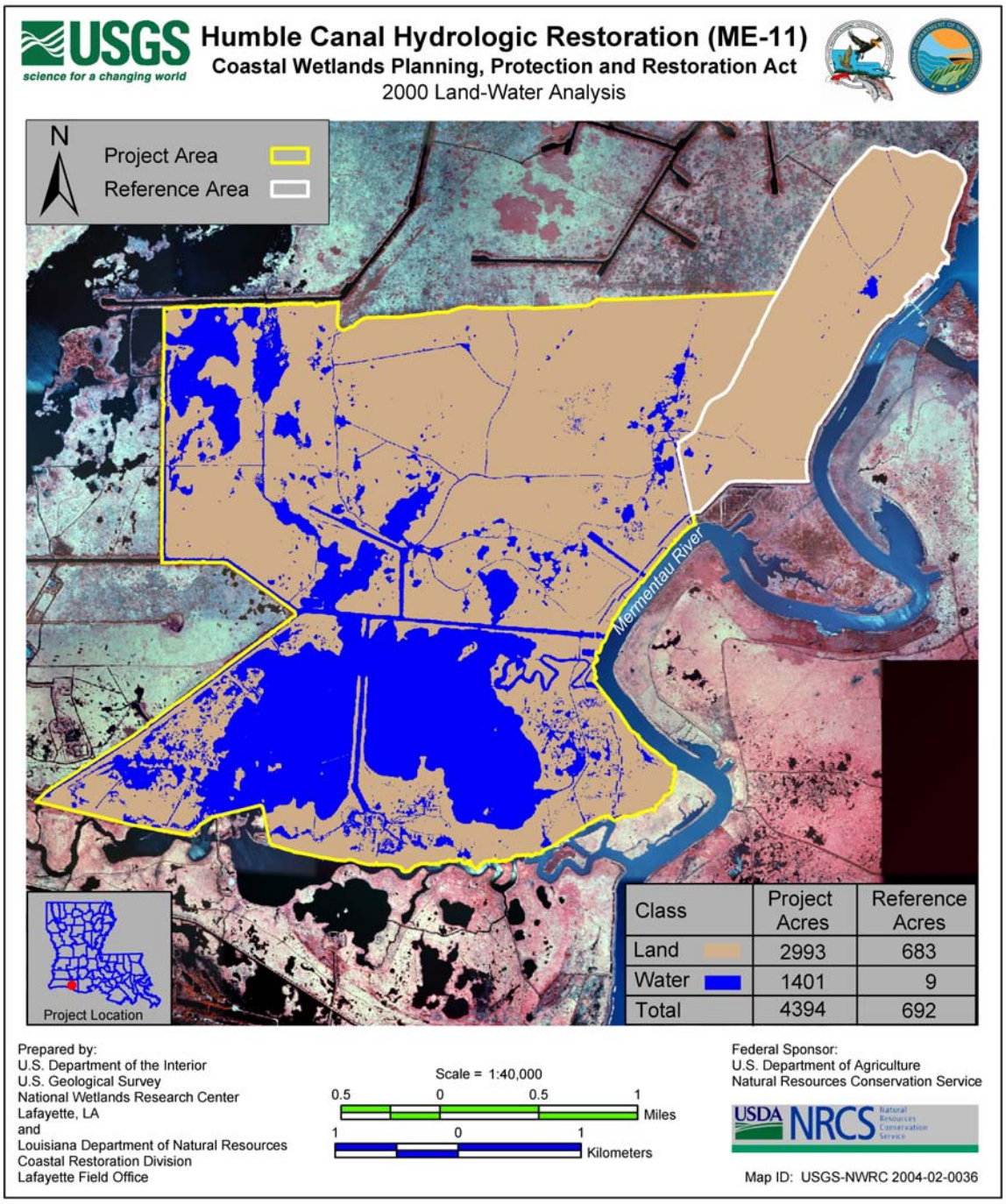

Figure 4. Land/water analysis of 2000 aerial photography showing the acreage of land and water in the project and reference areas of Humble Canal Hydrologic Restoration.

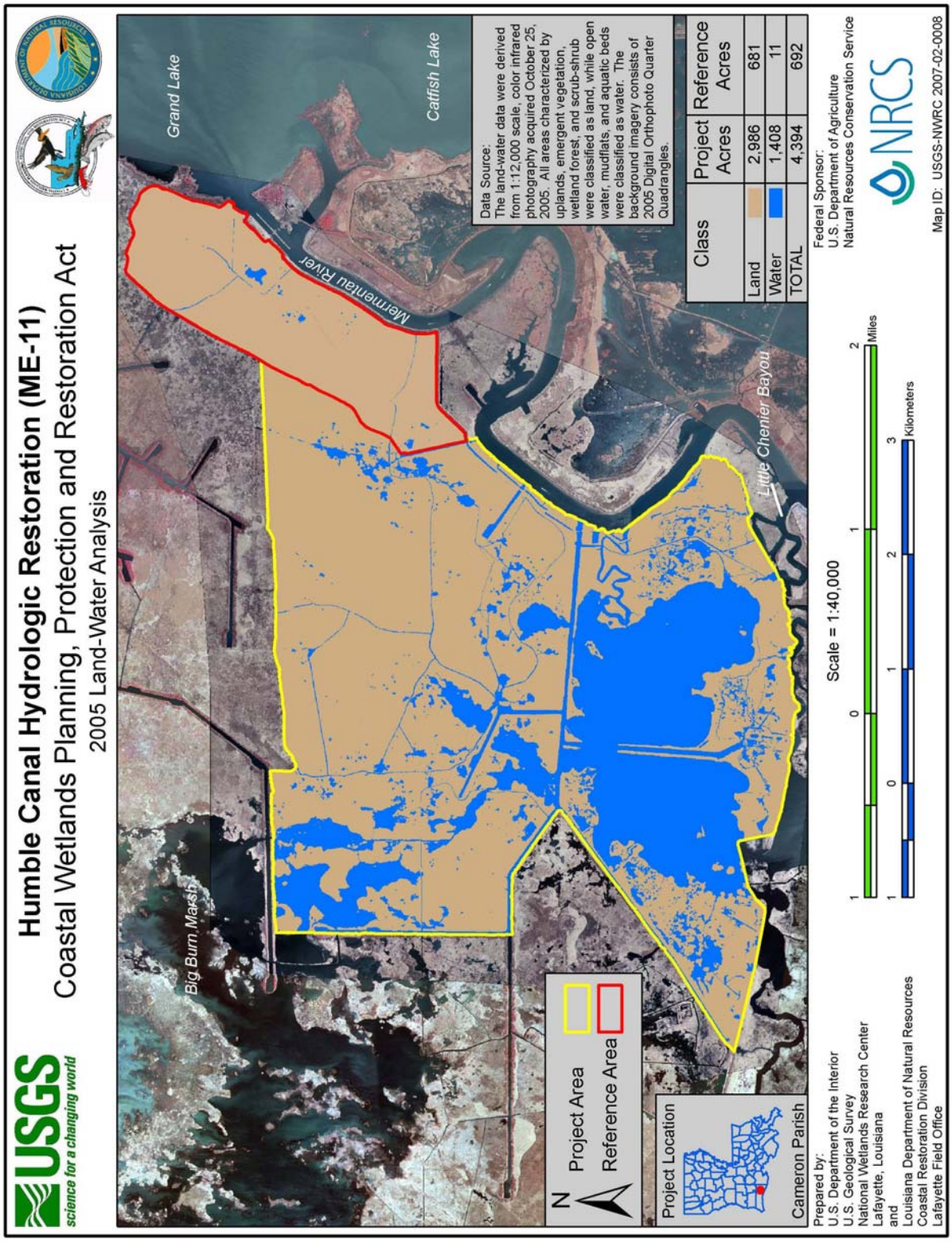

Figure 5. Land/water analysis of 2005 aerial photography showing the acreage of land and water in the project and reference areas of Humble Canal Hydrologic Restoration.

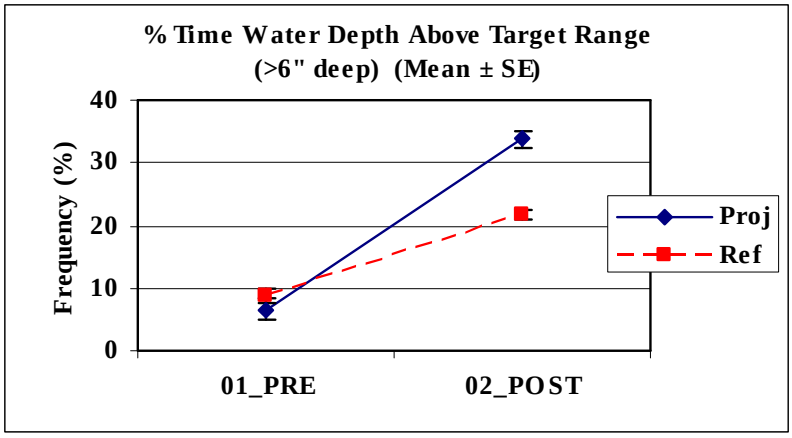

Figure 6. Proportion of days above target range for water level in the ME-11 project and reference areas pre- and post-construction. (X^2=13.8, p<0.05)

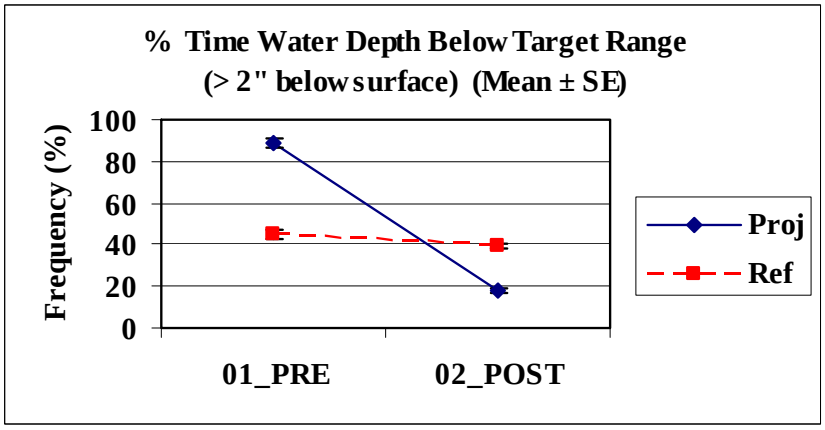

Figure 7. Proportion of days below target range for water level in the ME-11 project and reference areas pre- and post-construction. (X^2=338.5, p<0.05)

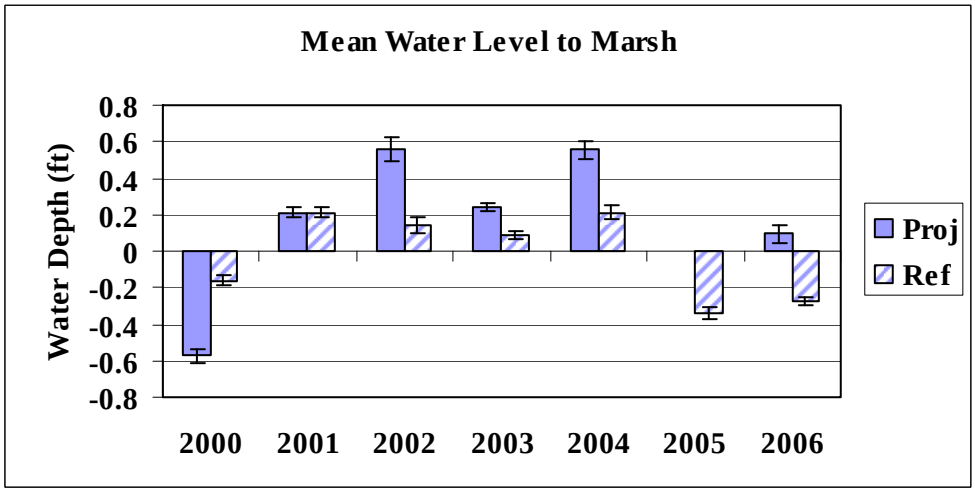

Figure 8. Mean daily water depth relative to marsh surface by year in the ME-11 project and reference areas.

Salinity:

The same stations and analyses were used for salinity as described for water level above. Target levels were 0 to 3 ppt and a maximum of 7 ppt. Salinities were above 3 ppt over 80% of the time in both the project and reference areas pre-construction. They decreased in both areas post-construction, significantly more in the project area (figure 9). Mean daily salinity was 7 ppt or greater in the project area 100% of the time and nearly 80% of the time in the reference area pre-construction. Post-construction, there were no high salinity events in the project area and only around 20% of the time in the reference area (figure 10). High salinities pre-construction were due to drought conditions. The project seems to have had the desired effect on salinity post-construction, where the proportion of time salinities were above the target decreased to a greater degree in the project area than the reference area.

In addition to the target range analyses, daily mean salinity was compared pre- and post-construction in the project and reference areas using ANOVA. The model included sampling area, time, stations nested within sampling area, and the interaction between sampling area and time. The overall model was significant but more importantly, the interaction between area and time was significant (figure 11). Salinity pre-construction was around 18 ppt in both the project and reference area (due to the drought). Mean daily salinities post-construction were 1.2 ppt in the project area and 4.7 ppt in the reference area. Salinities remained low post-construction until 2005 and 2006, when they increased in the reference area but not the project area (figure 12).

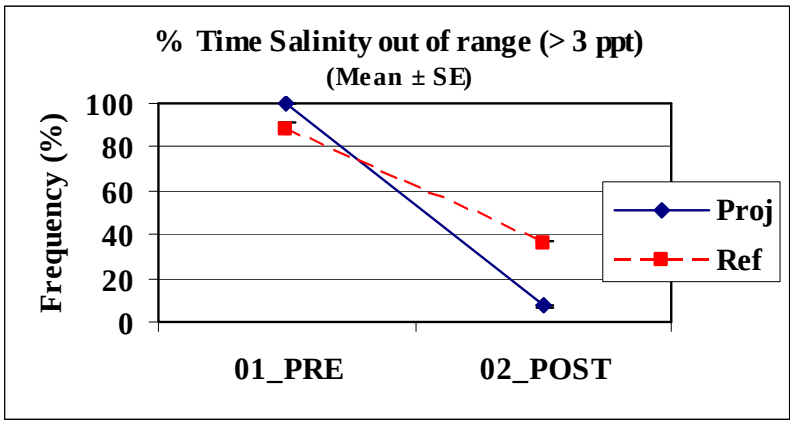

Figure 9. Proportion of days above target range of 3 ppt for salinity in the ME-11 project and reference areas pre- and post-construction. (X^2=69.2, p<0.05).

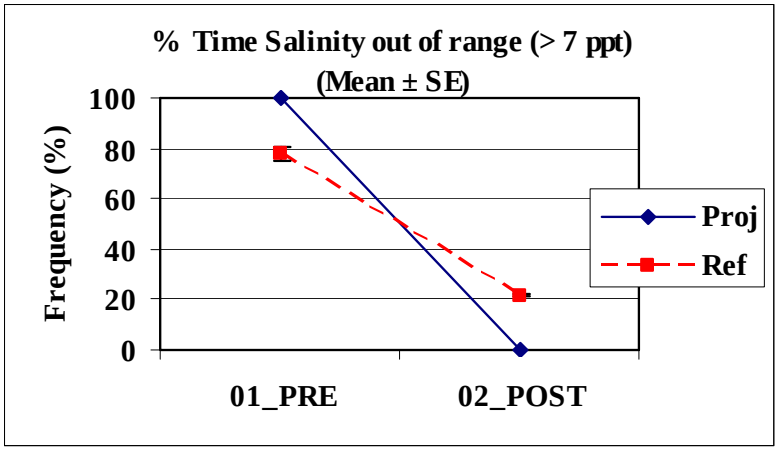

Figure 10. Proportion of days above target maximum of 7 ppt for salinity in the ME-11 project and reference areas pre- and post-construction. (X^2=209.6, p<0.05).

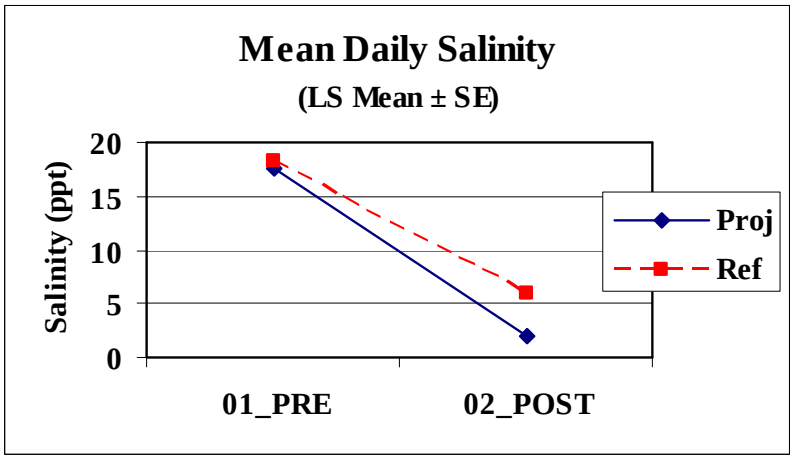

Figure 11. Least Squared Mean daily salinity in the ME-11 project and reference areas pre and post-construction. ($F_{1,1}$=18.1, p<0.05).

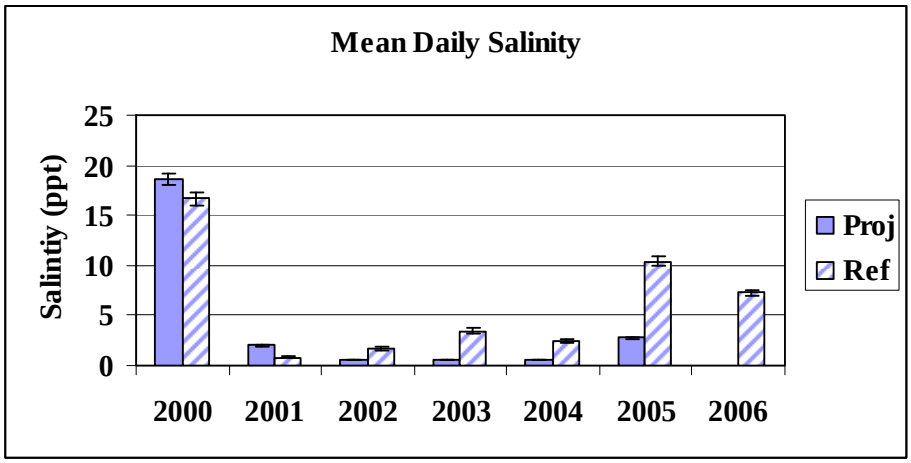

Figure 12. Mean daily salinity by year in the ME-11 project and reference areas.

Emergent Vegetation:

Emergent vegetation was sampled at 34 project stations and 12 reference stations in 2000 and 2003.

ANOVA was used to compare the project and reference area in 2000 and 2003 for total cover (%), species richness, and cover of the dominant, *Spartina patens*. None of the models were significant. Total cover (%) was slightly lower in the project area than the reference area in both 2000 and 2003 (figure 13). Species richness decreased in both project and reference areas from 2000 to 2003 (figure 14).

Both the project and reference area have diverse vegetative communities. There were 26 species found in the project area in 2000, and 21 found in 2003. The reference area was less diverse, with 18 species in 2000 and 11 in 2003. A species list with mean cover of each species when present can be found in table 1. In 2000, the project area was dominated by *Spartina patens*, with *Typha latifolia*, *Ipomoea sagittata*, and *Sagittaria lancifolia* frequently occurring (table 1). In 2003, *S. patens* occurred in every plot, but average cover for the species had declined from 82% to 50%. The reference area was essentially dominated by the same species as the project area in 2000 and 2003. Over the sampling interval, many species disappeared and many others re-appeared (table 1). New species commonly encountered in 2003 included: *Cladium jamaicence* (sawgrass), *Leersia hexandra*, and *Salix nigra* (black willow). Other new species encountered occasionally in the project and reference areas included: *Iva frutescens* (marsh elder), *Kosteletzkya virginica* (marsh hibiscus), *Schoenoplectus californicus* (California bulrush), *Vigna luteola* (deer pea), and *Pontedaria cordata* (pickerel weed).

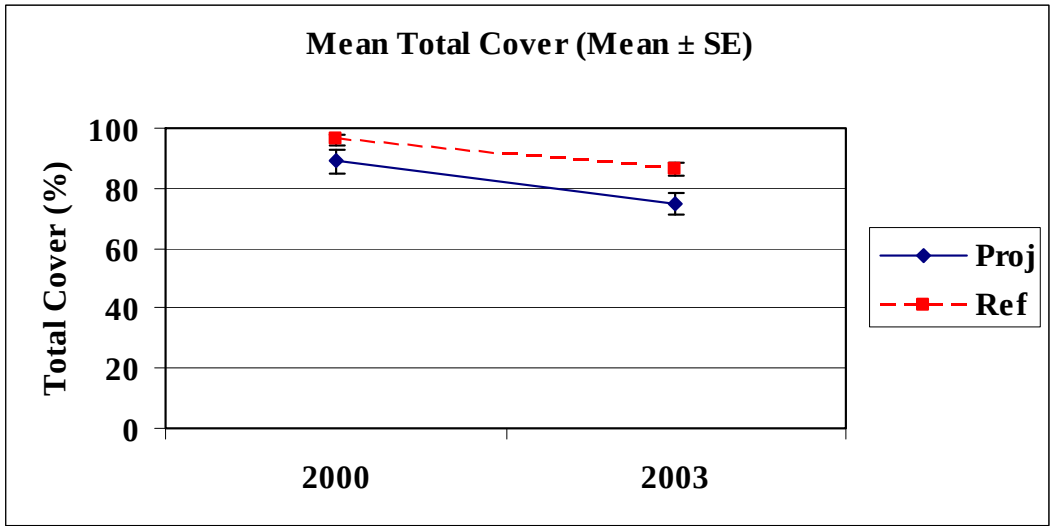

Figure 13. Mean Total Cover (%) of vegetation in the ME-11 project and reference areas. ($p>0.05$).

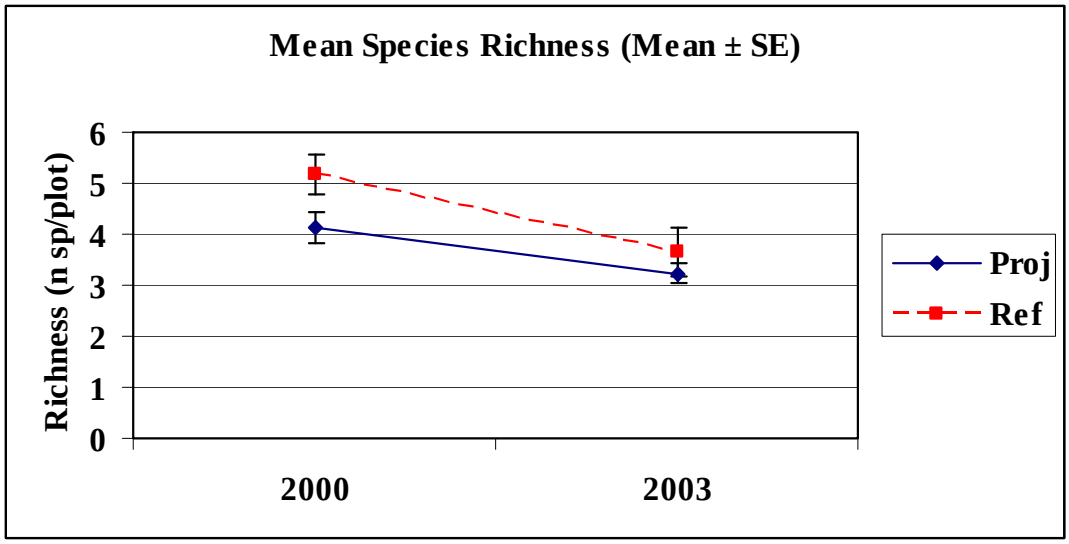

Figure 14. Mean species richness of vegetation in the ME-11 project and reference areas. ($p>0.05$).

Table 1. Cover (%) of species and frequency of occurrence of species in the project and reference areas in 2000 and 2003.

	% Cover of Species				Frequency of Occurrence			
	Project		Reference		Project		Reference	
Scientific Name	2000	2003	2000	2003	2000	2003	2000	2003
Alternanthera philoxeroides	8	.	5	.	6	.	8	.
Baccharis halimifolia	3	.	3	.	12	.	8	.
Cephalanthus occidentalis	5	11	.	.	6	9	.	.
Cladium mariscus ssp. *jamaicense*	.	43	.	.	.	6	.	.
Cyperus odoratus	1	2	1	5	3	9	17	8
Echinochloa walteri	5	.	4	.	24	.	25	.
Eclipta prostrata	.	.	2	.	.	.	25	.
Eupatorium capillifolium	5	.	.	.	3	.	.	.
Ipomoea sagittata	4	6	9	3	53	24	17	17
Iva frutescens	.	1	.	.	.	3	.	.
Kosteletzkya virginica	.	10	.	.	.	3	.	.
Leersia	.	20	.	12	.	12	.	25
Ludwigia	.	20	.	.	.	3	.	.
Ludwigia leptocarpa	3	.	.	.	6	.	.	.
Mikania scandens	5	15	14	.	24	3	58	.
Paspalum distichum	18	.	.	.	9	.	.	.
Paspalum	9	.	35	.	9	.	17	.
Phragmites australis	13	40	80	.	6	3	8	.
Pluchea odorata	0	.	1	.	9	.	8	.
Polygonum hydropiperoides	1	.	1	.	6	.	17	.
Polygonum punctatum	.	10	.	2	.	6	.	8
Pontederia cordata	.	.	.	1	.	.	.	8
Sacciolepis striata	8	1	1	1	12	6	8	17
Sagittaria lancifolia	8	10	9	21	38	38	58	67
Salix nigra	0	30	0	5	3	3	8	8
Schoenoplectus americanus	.	34	.	.	.	9	.	.
Schoenoplectus californicus	.	14	.	.	.	12	.	.
Schoenoplectus pungens	13	.	.	.	6	.	.	.
Schoenoplectus robustus	6	.	.	.	6	.	.	.
Setaria magna	1	.	.	.	3	.	.	.
Setaria pumila ssp. *pallidifusca*	3	.	2	.	9	.	8	.
Spartina alterniflora	2	.	.	.	3	.	.	.
Spartina patens	82	53	68	67	97	100	100	100
Symphyotrichum subulatum	.	1	.	.	.	3	.	.
Symphyotrichum tenuifolium	3	1	0	.	18	3	25	.
Typha latifolia	8	15	16	12	41	65	100	100
Vigna luteola	.	2	.	.	.	6	.	.
Zizaniopsis miliacea	15	.	.	5	3	.	.	8

Submerged Aquatic Vegetation:

Prior to project construction, there were no SAV species in the project area and only three species in the reference area (alga, *Ceratophyllum demersum*, and *Ruppia maritima*). At that time, salinities were prohibitively high for most SAV species (25.5 ppt in the project area, 21.6 in the reference). Following construction, the number of species in the project area rose to 4.2 species on average, while the reference area increased to 5 species. The increase occurred at the same rate in the project and reference area and was not statistically significant. Ten species of SAV were encountered in 2003 collectively (figure 15). Two species, *Cabomba carolinianum* (fanwort) and *Nelumbo lutea* (water lotus), were found in the project area and not in the reference area.

Mean salinities recorded during SAV sampling in both the project and reference areas were greater than 20 ppt in 2000 but did not exceed 5 ppt in 2003 (figure 16). In the reference area, the salt-tolerant *Ruppia maritima* (widgeon grass) comprised approximately 70% of the cover in 2000 and was absent in 2003. The fresh-to-intermediate species *Potamogeton pusillus* (baby pondweed) comprised 70% of the cover in 2003.

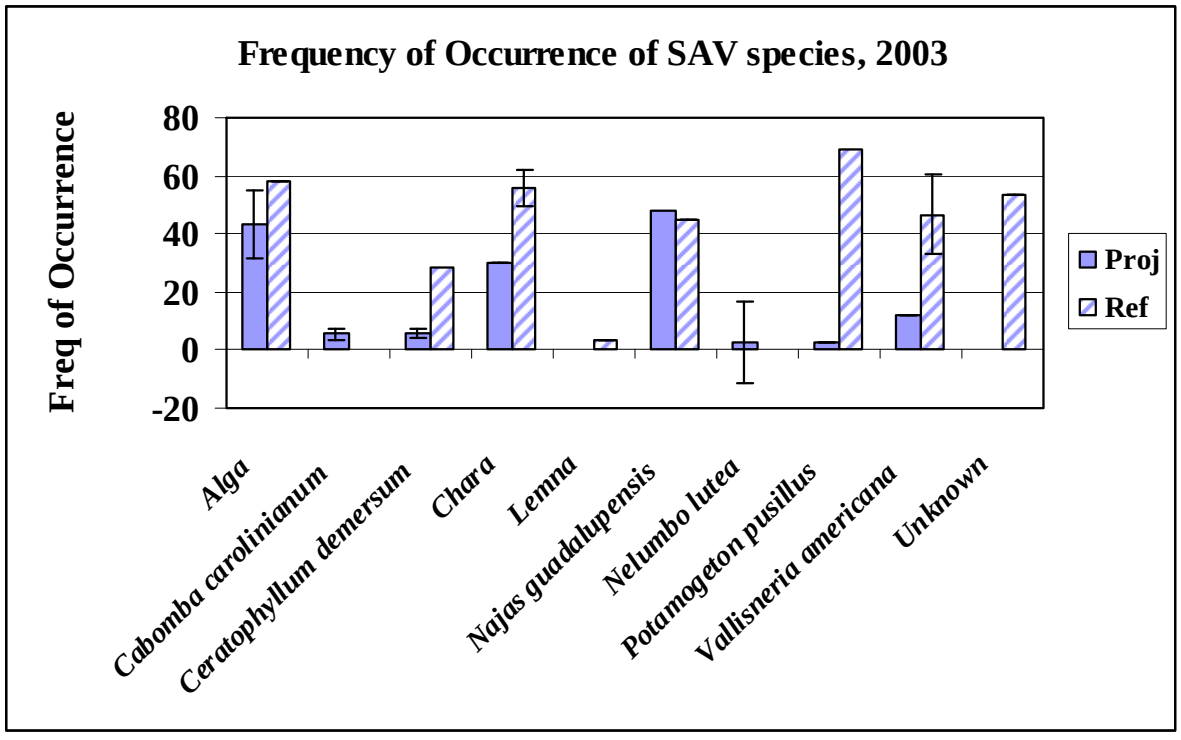

Figure 15. Frequency of occurrence of SAV species in the ME-11 project and reference areas in 2003.

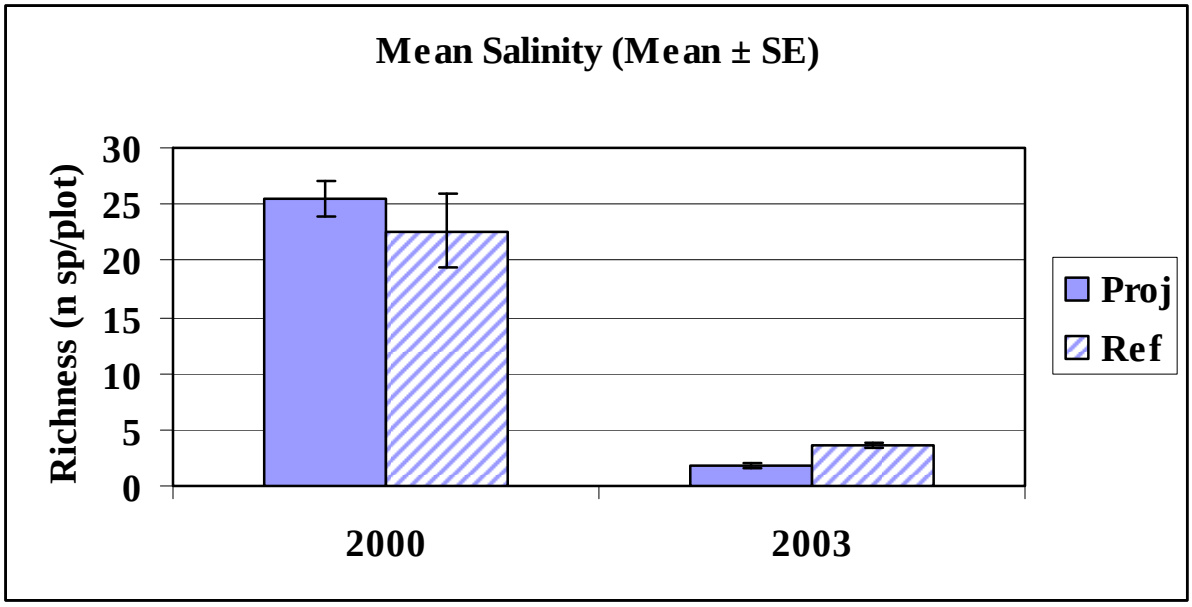

Figure 16. Mean salinity during SAV sampling in the project and reference area.

CRMS Soils:

Soil core data from the project site CRMS0624 and the reference site CRMS0605 were collected in November and May of 2006, respectively. The three cores collected from each site were summarized for pH, soil salinity, and bulk density by depth (figure 17). Both sites were acidic with soil pH from 5 to 6. Soil salinity at the reference site was higher in the surface sections than in the deeper sections. Both sites are organic down to 24 cm though the reference site is slightly more mineral than the reference site.

CRMS Porewater:

Porewater salinities are available from CRMS0624 and 605. CRMS0605 is available from May to December 2006 and CRMS0624 is available from December 2006. Salinities at 30 cm are almost always several ppt higher than salinities at 10 cm (figure 18).

CRMS Surface Elevation Change and Vertical Accretion:

Feldspar marker horizons were deployed and initial RSET readings were made at CRMS0624 on 4/19/07. Second readings are scheduled for fall of 2007. Initial readings were made at CRMS0605 on 3/23/06 and second readings and feldspar cores were collected on 4/19/2007. Elevation change over the interval at CRMS0605 was -12.6 ± 11.8 mm or -11.7 mm/yr. Accretion over the interval was 10.3 ± 6.4 mm or 9.6 mm/yr. Regional elevation change estimates based on movements of vertical datums in the area are -10 to -15 mm/yr (Shinkle and Dokka 2004). The RSET data are incidental at best over the short term. Subsidence estimates become stronger over time as trends emerge.

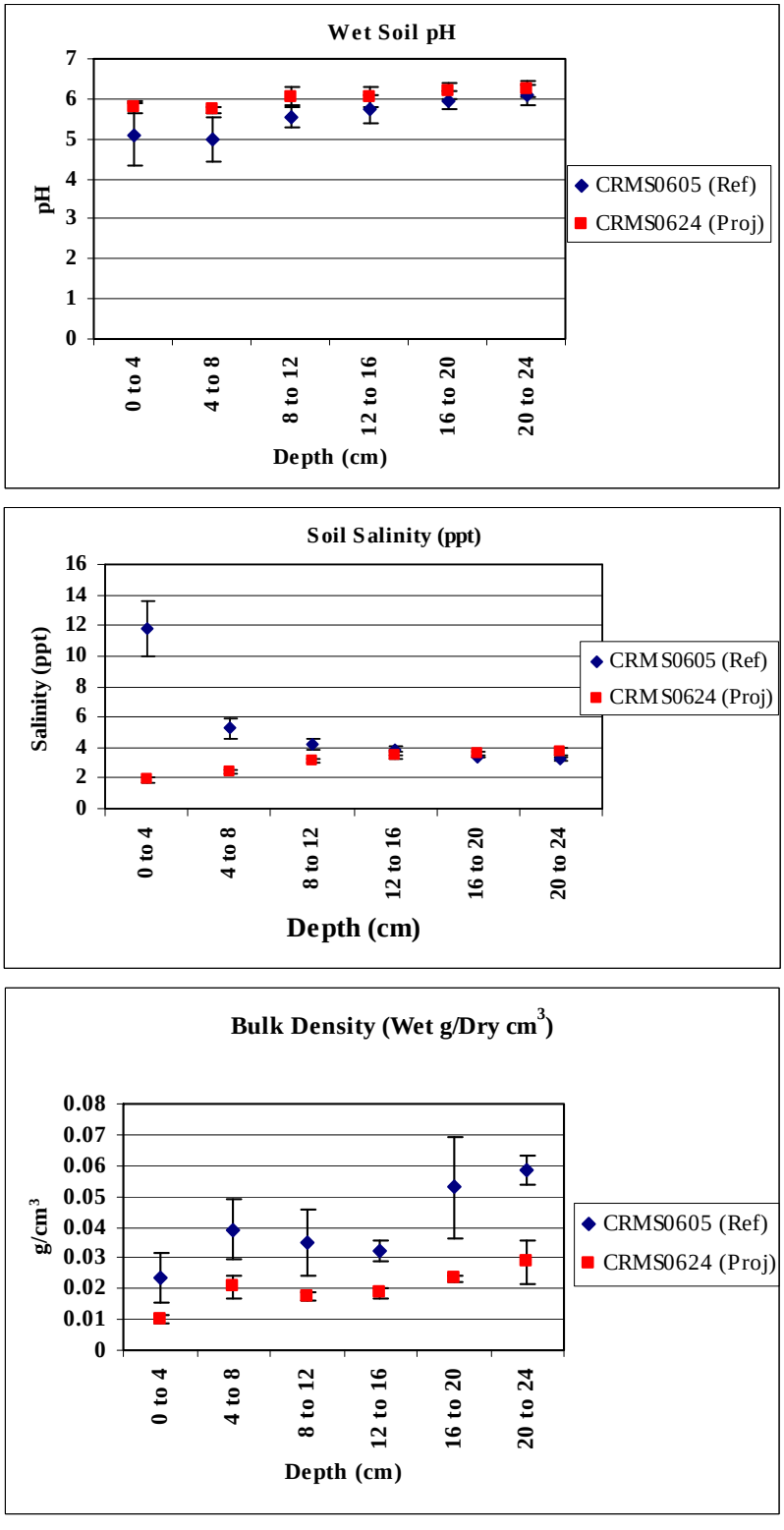

Figure 17. Soil Bulk pH, salinity, and bulk density at CRMS0605 and 0624.

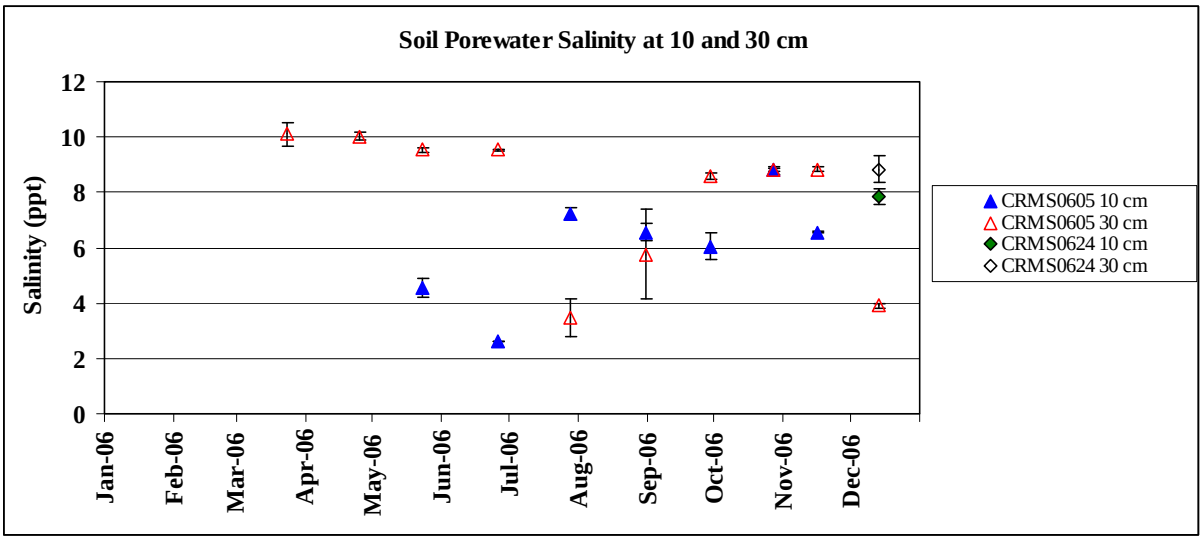

Figure 18. Porewater salinities at 10 and 30 cm at CRMS0624 and CRMS0605.

<u>Hurricane Rita Vegetation Results</u>:
A subset of nine project and three reference stations was sampled in 2005 and 2006 as part of a larger, regional Hurricane Rita damage assessment survey (see Appendix A). The subset of vegetation data collected from the ME-11 project and reference area as part of the Hurricane Rita vegetation survey were classified as either slightly stressed, stressed, severely stressed, or converted to open water. The subset of stations utilized were categorized as slightly stressed in 2003. In 2005, all of the stations were stressed and in 2006, half of the stations had recovered to slightly stressed and one station was severely stressed (figure 19). Total cover had decreased from pre-storm levels of around 75% to 73% in 2005 and 54% in 2006 (figure 20). Species richness decreased from a mean of 3.3 species in 2003 to 1.4 species in 2005 and increased to 4.7 species in 2006 (figure 21).

The subset of stations were also classified according to their Visser vegetation type (Visser et al. 2000) of which three were used to classify vegetation in the ME-11 Project area; Oligohaline Wiregrass, which is dominated by *Spartina patens*, Oligohaline Bullwhip, which is dominated by *Schoenoplectus californicus*, and Mesohaline Wiregrass, which is co-dominated by *Spartina patens* and *Schoenoplectus americanus*. In 2003 and 2005, all of the stations were classified as Oligohaline Wiregrass. In 2006, Oligohaline Bullwhip and Mesohaline Wiregrass had appeared (figure 22).

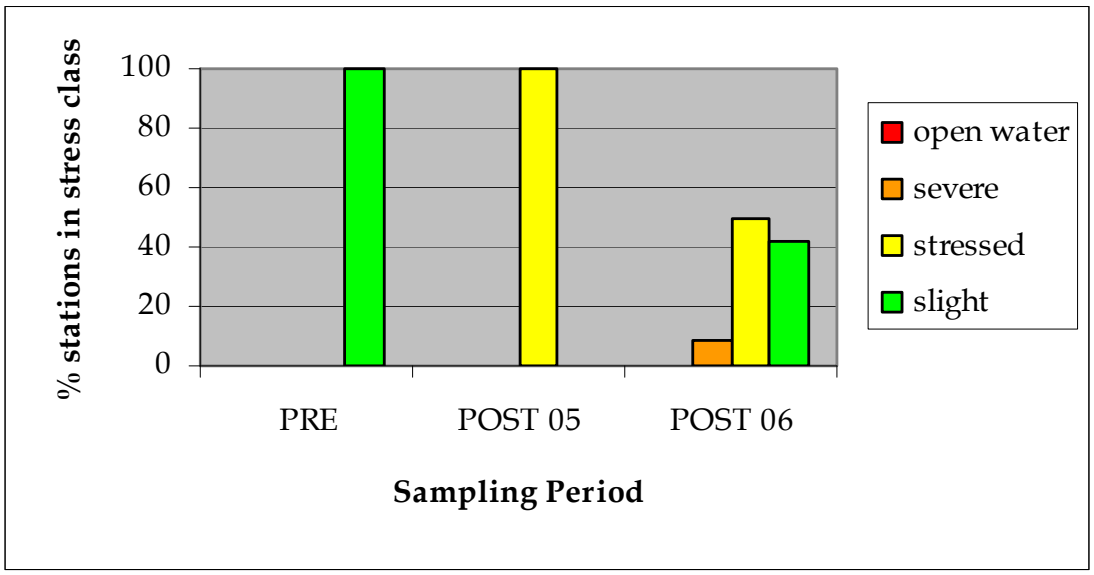

Figure 19. Percent of ME-11 vegetation stations in each stress class before and after Hurricane Rita (n=23).

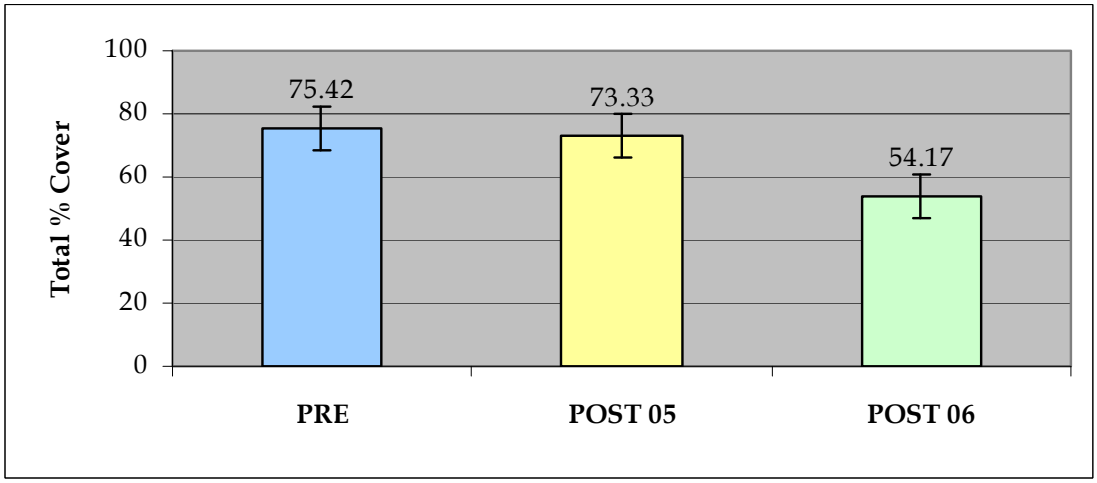

Figure 20. Total % Cover of vegetation at ME-11 pre- and post-Hurricane Rita.
LS Mean ± SE (n=23 stations). $F_{2, 68}$=2.82, p=0.0741. Levels connected by the same letter are not significantly different.

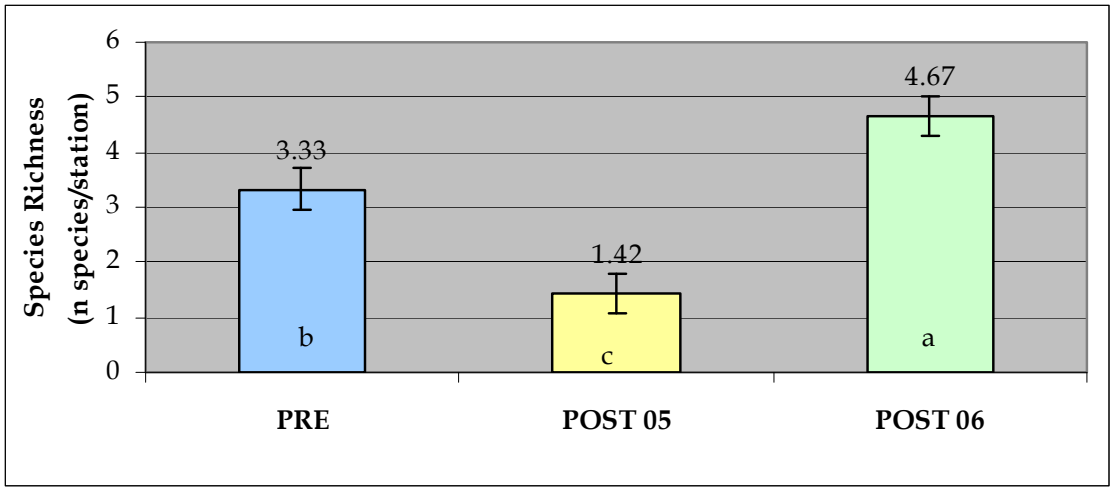

Figure 21. Species Richness at ME-11 pre- and post-Hurricane Rita. LS Mean ± SE (n=23 stations). $F_{2, 68}$=20.23, p<0.0001. Levels connected by the same letter are not significantly different.

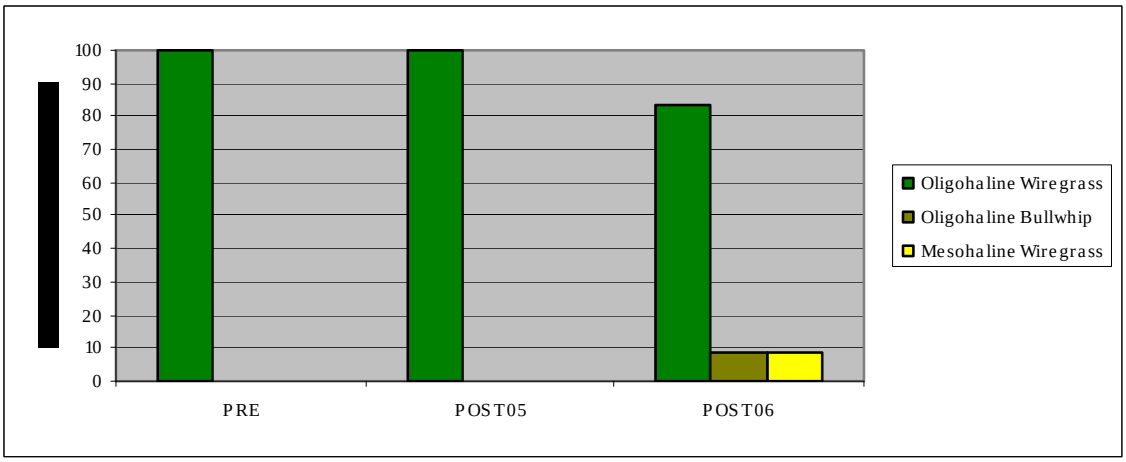

Figure 22. Percent of ME-11 vegetation stations in each Visser vegetation type before and after Hurricane Rita (n=23).

V. Conclusions

a. Project Effectiveness

The project appears to be maintaining (but not increasing) the land water ratio and the cover of emergent marsh vegetation. The goal of maintaining salinities within the target range for fresh emergent marsh vegetation was attained; however, mean water levels in the project area were above the target range more often after construction compared to the reference area (figure 8). The frequency of occurrence of SAV increased in both the project and reference areas.

Water levels were lowered in response to Hurricane Rita; the Cameron Parish Drainage District had to breach the levee to remove excess water. Post-Rita salinities remain high. The vegetation in the project area appears to be generally recovering from Hurricane Rita. Vegetative cover is approaching pre-storm levels and the area is more diverse due to disturbance species and the emergence of new marsh types.

Overall the project is performing as desired according to project goals. Further analysis of water level data following storm and high water events may determine the need for additional drainage.

b. Recommended Improvements

Overall, the Humble Canal Hydrologic Restoration Project structural components are in good condition and are functioning as designed; however, some maintenance is required as listed below. Plans and specifications will be prepared to address these issues. A Federal Emergency Management Agency (FEMA) claim has been submitted for a portion of the repair work needed on the structure. Miami Corporation will continue efforts to identify the owner of the camp building and options for removal.

- Repair and/or replace miscellaneous hardware.
- Add crushed stone on top of structure.
- Clean wrack and debris from structure.

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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).

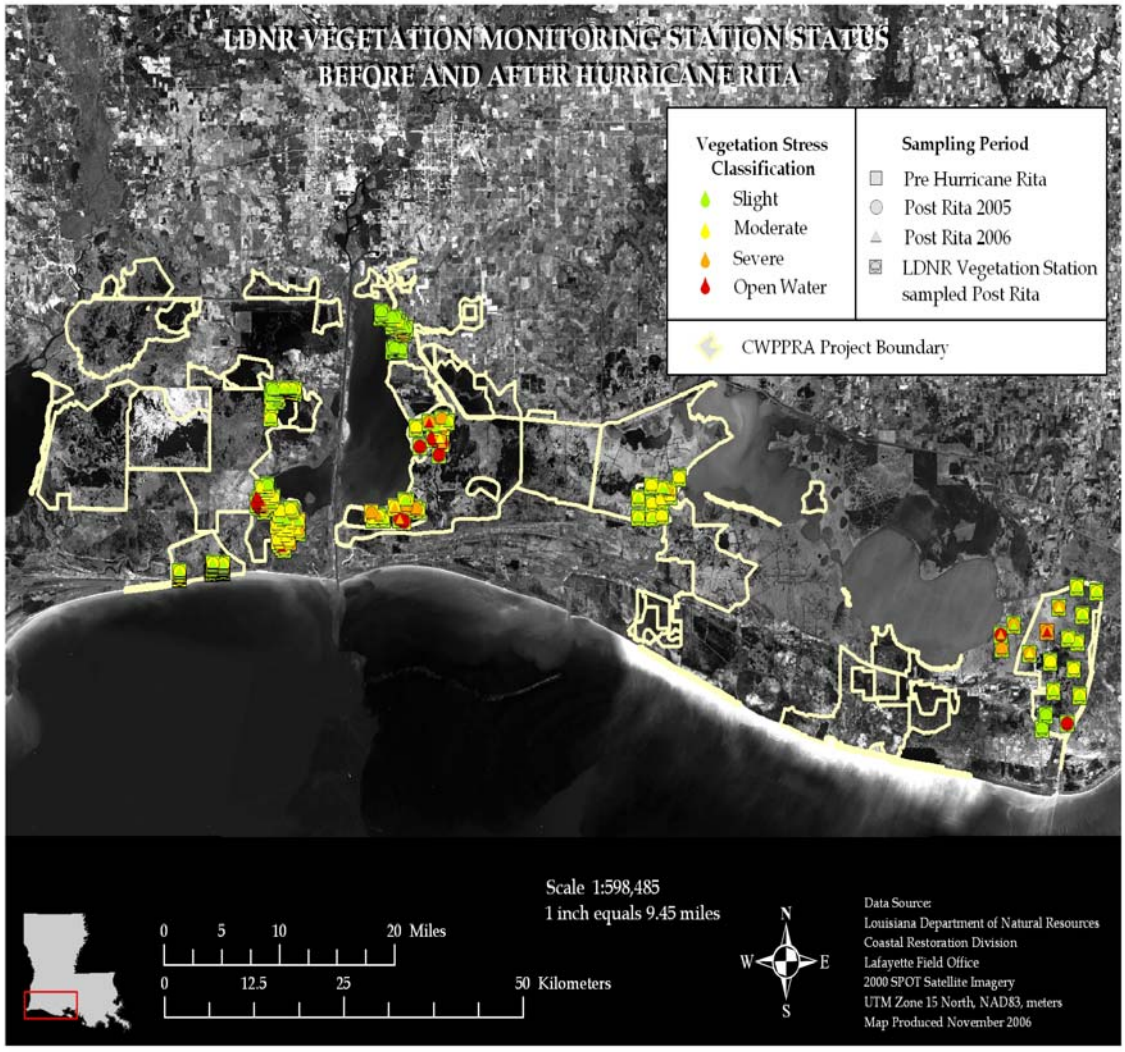

Figure 1. Location and status of LDNR vegetation stations sampled after Hurricane Rita. Stations were classified according to storm-induced stress as described in Table 1.

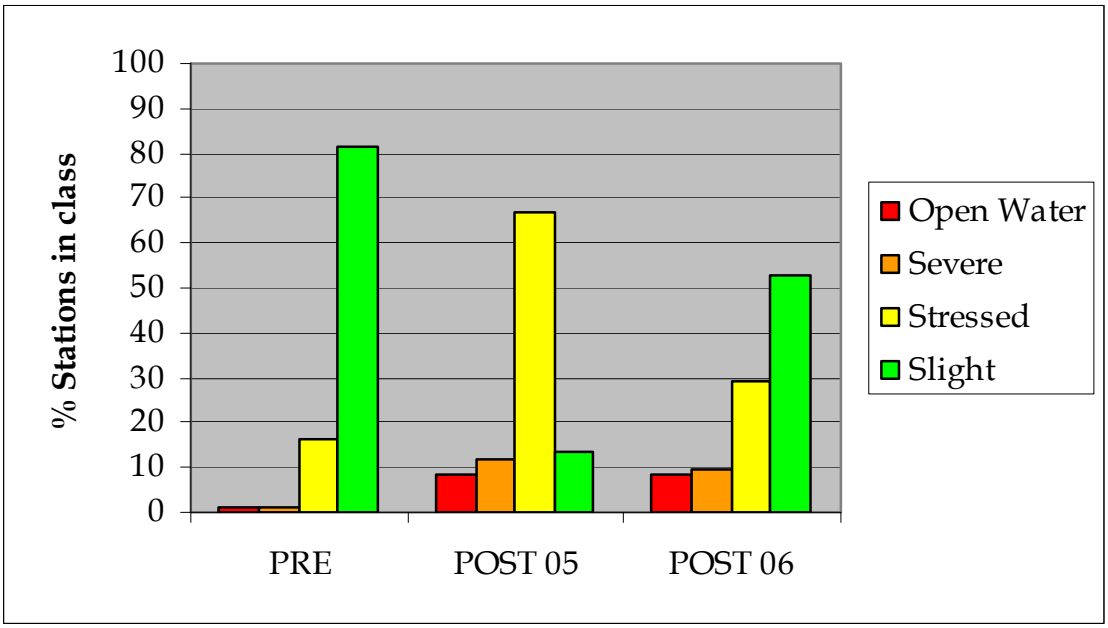

Figure 2. Percent of LDNR vegetation stations in each stress class before and after Hurricane Rita (n=163).

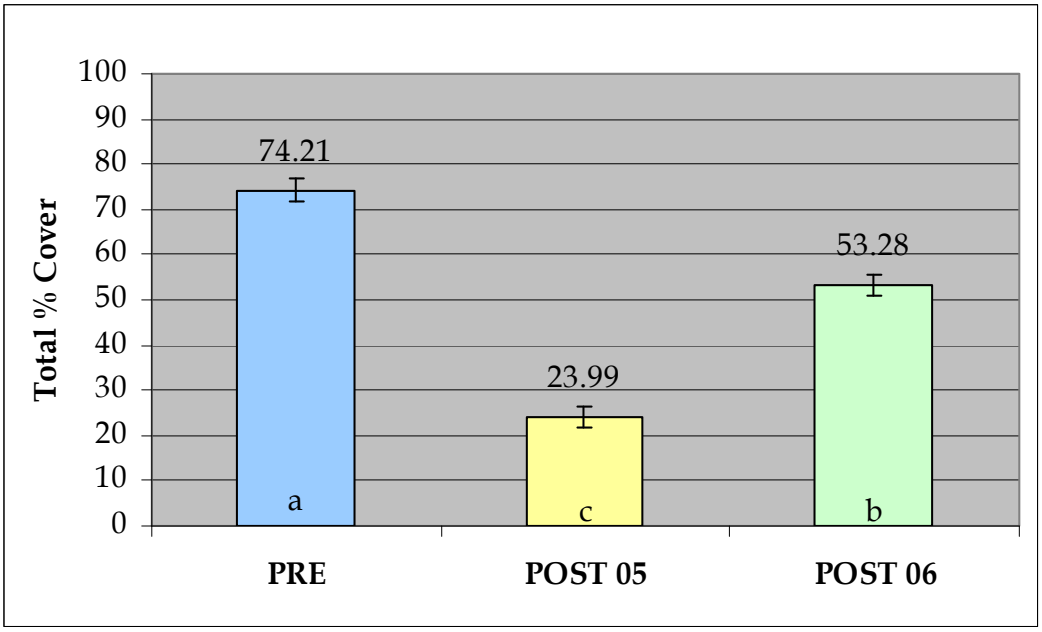

Figure 3. Total % Cover pre- and post-Hurricane Rita. LS Mean ± SE, n=163 stations, $F_{2, 488}$=109.7, p<0.0001. Levels not connected by same letter are significantly different.

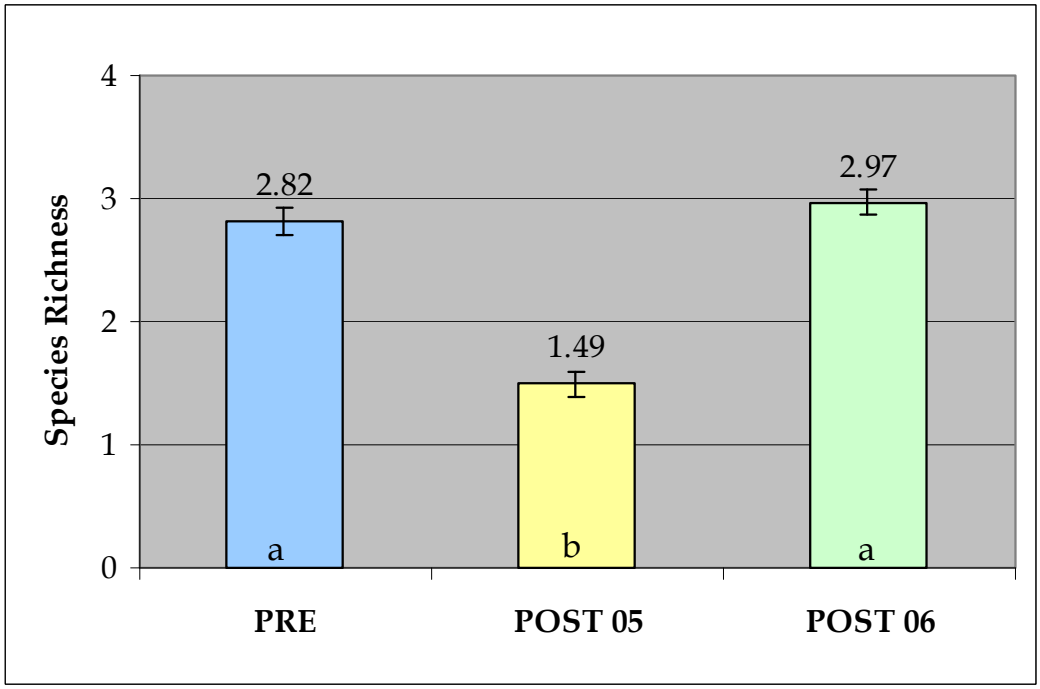

Figure 4. Species Richness pre- and post-Hurricane Rita. LS Mean ± SE, n=163 stations, $F_{2, 488}$=56.8, p<0.0001. Levels not connected by same letter are significantly different.

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.

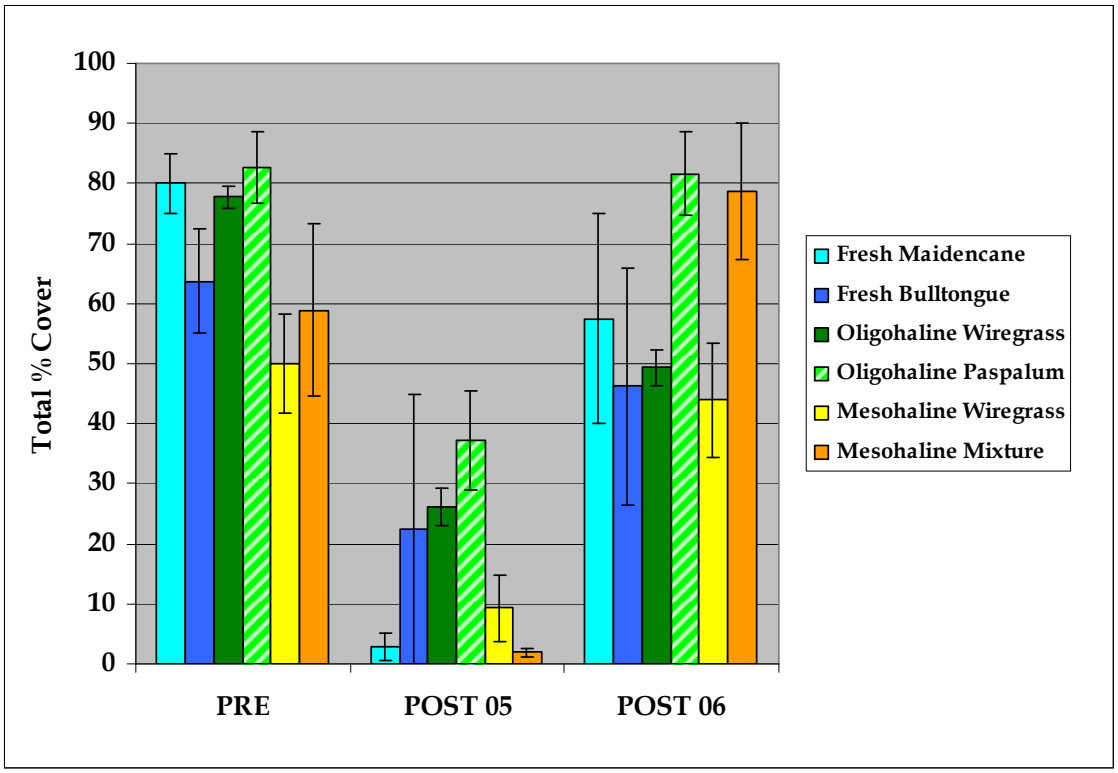

Figure 5. Total % Cover by Visser Vegetation Type. LS Mean ± SE, n=163 stations, $F_{17, 488}$=17.0, p<0.0001.

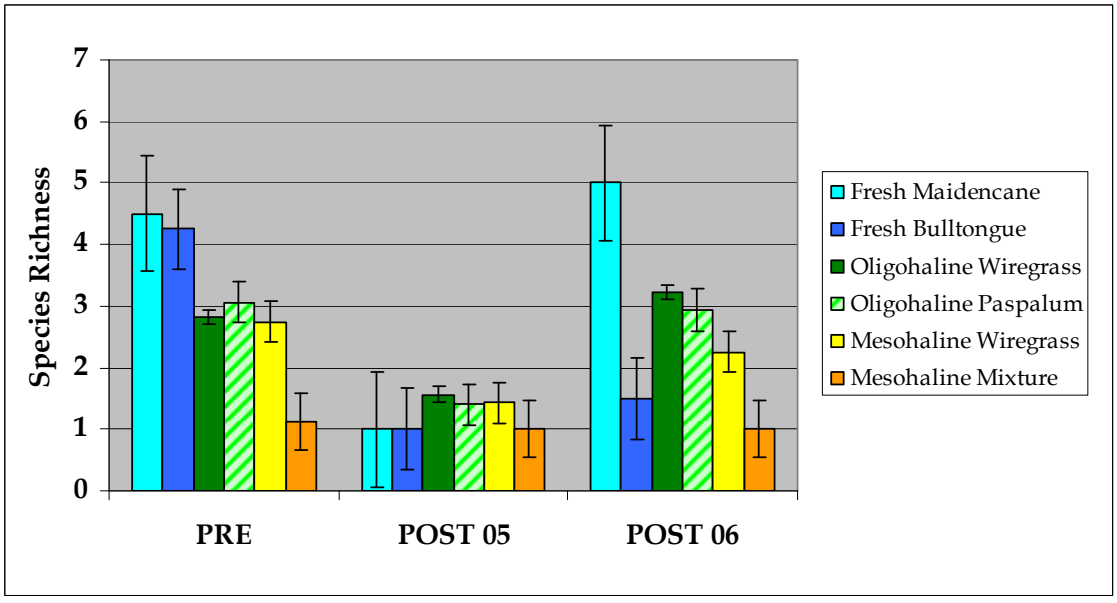

Figure 6. Species Richness by Visser Vegetation Type. LS Mean ± SE, n=163 stations, $F_{17, 488}$=10.9, p<0.0001.

REFERENCES

Visser, J. M., C. E. Sasser, 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)

(Inspection Photographs)

Photo 1, Marine barrier with signage.

Photo 2, Inlet side showing hyacinth fence in background covered with debris, as well as embankment of structure.

Photo 3, Outlet side of structure.

Photo 4, Showing camp on southern end of structure and erosion on embankment.

Photo 5, Showing inlet channel, view looking north.

Photo 6, Earthen plug replaced by Cameron Parish Gravity District after high water levels receded.

Appendix C
(Three Year Budget Projection)

Appendix C
(Three Year Budget Projection)
HUMBLE CANAL / ME-11 / PPL8
Three-Year Operations & Maintenance Budgets 07/01/2007 - 06/30/10

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

	2007/2008	2008/2009	2009/2010
Maintenance Inspection	$ 5,407.00	$ 5,570.00	$ 5,737.00
Structure Operation	$ -	$ -	$ -
Administration	$ 9,000.00		$ -
Maintenance/Rehabilitation			

07/08 Description:Maintenance event to clean inlet channel,repair rock embankment (damages from Hurricane RITA)

E&D	$ 10,000.00
Construction	$ 64,500.00
Construction Oversight	$ 18,000.00
Sub Total - Maint. And Rehab.	$ 92,500.00

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	**$ 106,907.00**	**$ 5,570.00**	**$ 5,737.00**

O &M Budget (3 yr Total)	**$ 118,214.00**
Unexpended O & M Budget	**$ 207,103.41**
Remaining O & M Budget (Projected)	**$ 88,889.41**

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

HUMBLE CANAL HR PROJECT / PROJECT NO. ME-11 / PPL NO. 8

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	$10,000.00	**$10,000.00**
Operations Contract	LUMP	1	$0.00	**$0.00**
Construction Oversight	LUMP	1	$18,000.00	**$18,000.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	1	$7,000.00	$7,000.00
FEDERAL SPONSOR Admin.	LUMP	1	$2,000.00	$2,000.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$9,000.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Rip rap	0	0.0	45	$200.00	$9,000.00
Aggregate Surface Course	0	0.0	60	$200.00	$12,000.00
	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	1	$0.00	$0.00
Materials		LUMP	1	$0.00	$0.00
Mob / Demob		LUMP	1	$22,500.00	$22,500.00
Contingency		LUMP	1	$0.00	$0.00
General Structure Maintenance		LUMP	1	$21,000.00	$21,000.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$64,500.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$106,907.00**

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

HUMBLE CANAL HR PROJECT / PROJECT NO. ME-11 / PPL NO. 8

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	1	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	1	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Rip rap	0	0.0	0	$0.00	$0.00
Aggregate Surface Course	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	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 WORKSHEET 07/01/2009 - 06/30/2010

HUMBLE CANAL HR PROJECT / PROJECT NO. ME-11 / PPL NO. 8

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 SPONSOR Admin.	LUMP	1	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Rip rap	0	0.0	0	$0.00	$0.00
Aggregate Surface Course	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	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)

(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-11 Humble Canal

Date of Inspection: December 4, 2006 Time: 11:00am

Structure No. N/A

Inspector(s): LDNR- Mel Guidry & Darrell Pontiff
NRCS- Dale Garber
Acadian Engineers-Andre Aucoin & Donnie Saucier

Structure Description: 5 - 48" x 50' corrugated aluminum pipe with weir type drop inlets and flap gated outlets/ 1 1 - 18" x 50' corrugated alum.pipe w

Water Level Inside

Type of Inspection: Annual

Weater Conditions: Sunny and Cold

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good				
Steel Grating	good				
Stop Logs	good				Stoplogs on this structure are made of aluminum and should last practically forever.
Hardware	fair			3	Some of the hardware needs to be replaced or repaired.
Timber Piles	good				
Timber Wales	good				
Galv. Pile Caps	good				
Cables/ lifting device	good				
Signage /Supports	good				
Rip Rap (fill) (foreshore dike)	good				
Eathern	good			4	Erosion has occurred behind each wingwall and over the structure.
Embankment				4	A camp building has been deposited on the southern end of the structure.
Inlet Channel/Plug				5 & 6	Inlet channel completely cleared of wrack & debris, earthen plug replaced by Cameron Parish GDD.

What are the conditions of the existing levees?	Stable on both the inlet and outlet channels. Exposed cloth near the structure as noted.
Are there any noticable breaches?	No
Settlement of rock plugs and rock weirs?	N/A
Position of stoplogs at the time of the inspection?	Unkown
Are there any signs of vandalism?	No

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-11 Humble Canal

Date of Inspection: December 4, 2006 Time: 11:00am

Structure No. N/A

Inspector(s): LDNR- Mel Guidry & Darrell Pontiff
NRCS- Dale Garber
Acadian Engineers-Andre Aucoin & Donnie Saucier

Structure Description: Marine Barrier Fence

Water Level Inside

Type of Inspection: Annual

Weater Conditions: Sunny and Cold

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good				
Steel Grating					
Stop Logs	N/A				
Hardware	good				
Timber Piles	good				
Timber Wales	good				
Galv. Pile Caps	good				
Cables	N/A				
Signage /Supports	good			1	Some odd shrinkage of the lettering on the warning signs. Still no cause for concern. Signs slightly bent from Hurricane RITA damage.
Rip Rap (fill)	N/A				
Eathern Embankment	N/A				

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

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-11 Humble Canal

Date of Inspection: December 4, 2006 Time: 11:00am

Structure No. Hyacinth Fence

Inspector(s): LDNR- Mel Guidry & Darrell Pontiff
NRCS- Dale Garber
Acadian Engineers-Andre Aucoin & Donnie Saucier

Structure Description:

Water Level Inside

Type of Inspection: Annual

Weater Conditions: Sunny and Cold

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	good				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	fair			4	Hyacinth fence is covered with wrack and debris.
Timber Piles	good				
Timber Wales	good				
Galv. Pile Caps	good				
Cables	N/A				
Signage /Supports	N/A				
Rip Rap (fill)	N/A				
Earthen Embankment	N/A				

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