State of Louisiana
Department of Natural Resources
Coastal Restoration Division

Monitoring Plan

for

Holly Beach Sand Management

State Project Number CS-31
Priority Project List 11

August 2003
Cameron Parish

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MONITORING PLAN

PROJECT NO. CS-31
HOLLY BEACH TO CONSTANCE BEACH SEGMENTED BREAKWATERS ENHANCEMENT AND SAND MANAGEMENT PROJECT

ORIGINAL DATE: August 28, 2002
REVISED DATES: June 11, 2003; August 14, 2003

<u>Preface</u>

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System (CRMS-*Wetlands*) for CWPPRA, this Monitoring Plan was reviewed to facilitate merging it with CRMS to provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. The implementation plan included review of monitoring efforts on currently constructed projects for opportunities to 1) determine if current monitoring stations could be replaced by CRMS stations, 2) determine if monitoring could be reduced to evaluate only the primary objectives of each project and 3) determine whether monitoring should be reduced or stopped because project success had been demonstrated or unresolved issues compromised our ability to actually evaluate project effectiveness. As a the result of a joint meeting with DNR, USGS, and the federal sponsor, the recommendations for this Monitoring Plan were to maintain it in its current form. Consequently, no changes were made as a result of the CRMS review.

<u>Project Description</u>

The Holly Beach to Constance Beach Segmented Breakwaters Enhancement and 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). This region of coastal Louisiana is referred to as the Chenier Plain in reference to its unique geologic formations, the stranded beach ridges called cheniers (French for "oak") by early Acadian settlers because they were generally covered with forests of live oak (*Quercus virginicus*). 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 Wetland Research Center [USGS-NWRC] 2001). The project area is divided into two areas separated by the Louisiana Highway 82 embankment (figure 1). 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.

The Chenier Plain is characterized by alternating or coalescing shore-parallel ridges composed primarily of sand, shell, and shell fragments deposited on top of and separated from each other by swales of emergent marsh on alluvial deposits. These features developed over the past 3,000 to 4,000 years in a marginal deltaic environment during a series of shoreline transgressions and regressions (Gould and McFarland 1959), and occur in a 12 to 20 mile (19.3 to 32.2 km) wide band stretching approximately 125 miles (201 km) from southeast Texas to Southwest Point in Iberia Parish, Louisiana.

Figure 1. Holly Beach to Constance Beach Segmented Breakwaters Enhancement and Sand Management (CS-31) project area and features.

The general mechanism of deposition along the Chenier Plain shoreline was closely related to variations in the influx of alluvial sediment transported westward by the littoral transport system as the Mississippi River oscillated between sub-deltas (Gould and McFarland 1959, Byrnes and McBride 1995). The swales are the result of rapid deposition of large quantities of reworked alluvial sediments, mostly fine clay and silt, supplied by the Mississippi River during a western oscillation of delta formation, creating huge mudflats, and prograding the shoreline.

In their study of historical shoreline dynamics along Louisiana's Gulf of Mexico shoreline, Byrnes et al. (1995) found that the shoreline between Sabine Pass and Calcasieu Pass could be divided into six areas, based on trends in shoreline movement for the period 1883 to 1994 (figure 2). Area 1, the shoreline between Sabine Pass and Ocean View Beach, shows a net shoreline advance of 11.5 ft/yr (3.5 m/yr). Area 2, the shoreline between Ocean View Beach and just west of Holly Beach, is erosional, with an average change rate of -3.9 ft/yr (-1.2 m/yr), and a maximum retreat rate of -8.2 ft/yr (-2.5 m/yr). Area 3, Holly Beach, and Area 4, a 1.0 mi (1.6 km) long segment of shoreline to the east, have remained stable for the 111-year time period. Area 5, a 5.24 mi (8.45 km) long reach of shoreline east of the stable Holly Beach area is erosional, with an average change rate of -4.6 ft/yr (-1.4 m/yr), and a maximum retreat rate of -9.2 ft/yr (-2.8 m/yr). Area 6, a 0.43 mi (0.7 km) long segment of shoreline adjacent to the west jetty of Calcasieu Pass is advancing, with an average change rate of 7.2 ft/yr (2.2 m/yr). Further analysis showed that the length of shoreline in Area 1 is decreasing and the magnitude of advancement is declining over time, while the length of shoreline in Area 2 is increasing over time and the magnitude of change has remained relatively consistent. The length of shoreline in Area 5 has changed significantly, and the magnitude of retreat has steadily

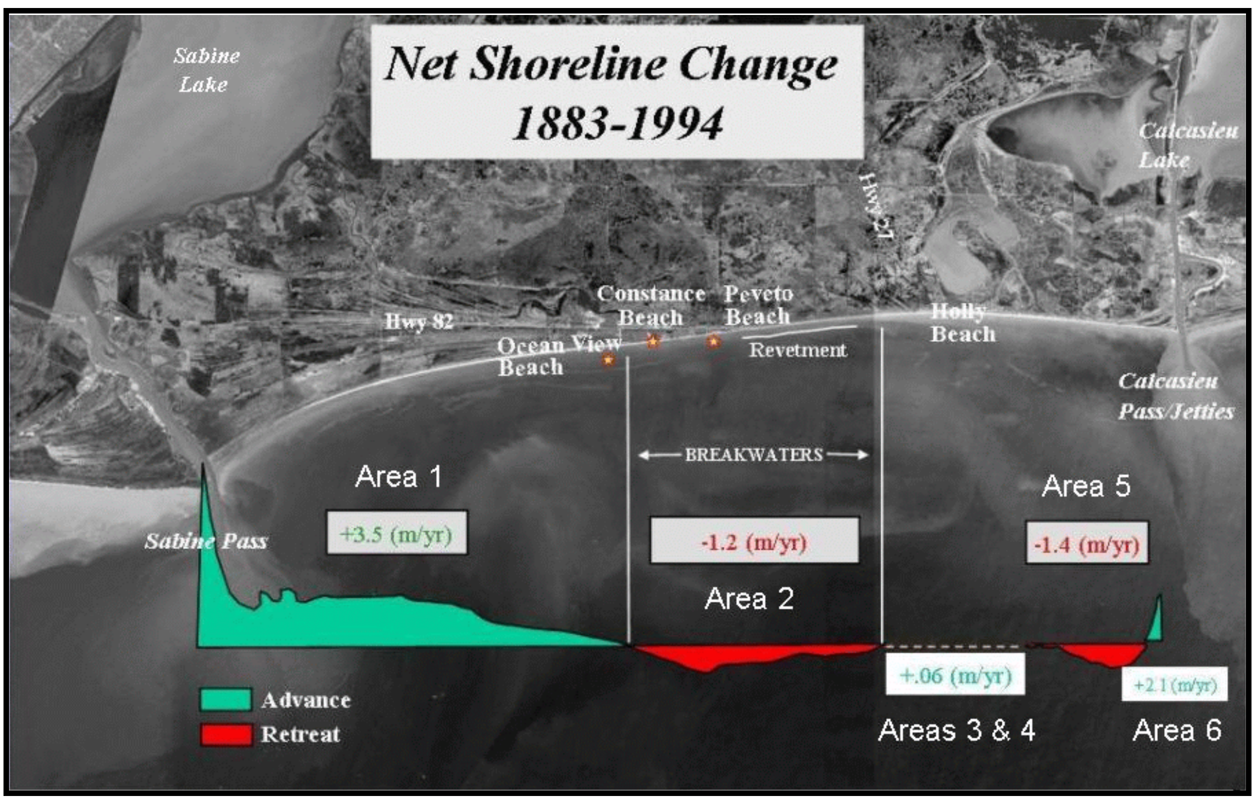

Figure 2. Net shoreline change from 1883-1994 along the Gulf of Mexico shoreline of southwestern Louisiana. Figure modified from Byrnes and McBride (1995).

increased over time. These observations also indicate a reduction in sediment availability to the subaerial beach (Byrnes et al. 1995).

Chronic erosion in this area today 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).

Louisiana State Highway 82 runs atop a series of ridges or cheniers between Pecan Island, Louisiana and Sabine Lake. Between Holly Beach and Constance Beach, the highway has been moved inland several times to prevent shoreline erosion from washing it away. In 1971, the Louisiana Department of Transportation and Development (LDOTD) constructed several miles of concrete block revetment along this section of the highway (figures 2 and 3) to protect it and the underlying ridge from shoreline erosion. The revetment has been successful in restricting shoreline erosion, but sections of highway have been washed out and destroyed by wave erosion (figure 4), usually associated with the passage of a tropical system such as Tropical Storm Allison, which undermined the roadway in several locations during the week of June 4-10, 2001. Engineering data indicate that due to an unfavorable beach profile in this area and the smooth surface of the revetment, incoming waves are met with very little resistance, so overtopping of the highway and wave over-wash into the marsh north of the highway is common (Coastal Planning and Engineering, Inc. [CPE] 2000).

Between 1991 and 1995, the Louisiana Department of Natural Resources (LDNR) constructed a series of 85 segmented breakwaters along the shoreline in four phases (figure 2). These structures have produced a favorable but limited beach response by the formation of salients and tombolas landward of the breakwaters (Byrnes and McBride 1995, Underwood et al. 1999). However, further study of the beach response to the breakwater field indicates that due to a lack of sediment in the littoral transport system, erosion rates have increased in areas down drift of the project area (CPE 2000). Also, the beach response to the existing breakwaters is not predicted by any known models. Additional data must be collected and evaluated to develop an appropriate model.

Today, this ridge is the only remaining hydrological 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 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 to the north.

The acreage of marsh has remained fairly stable over the past 50 years in the project area, experiencing an estimated land loss rate of only 0.37% per year between 1956 and 1990 (USGS-NWRC 2001). A future land loss rate of 0.2% has been predicted for the Second Bayou Mapping Unit (Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority [LCWCRTF and WCRA] 1998), which includes most of project area A.

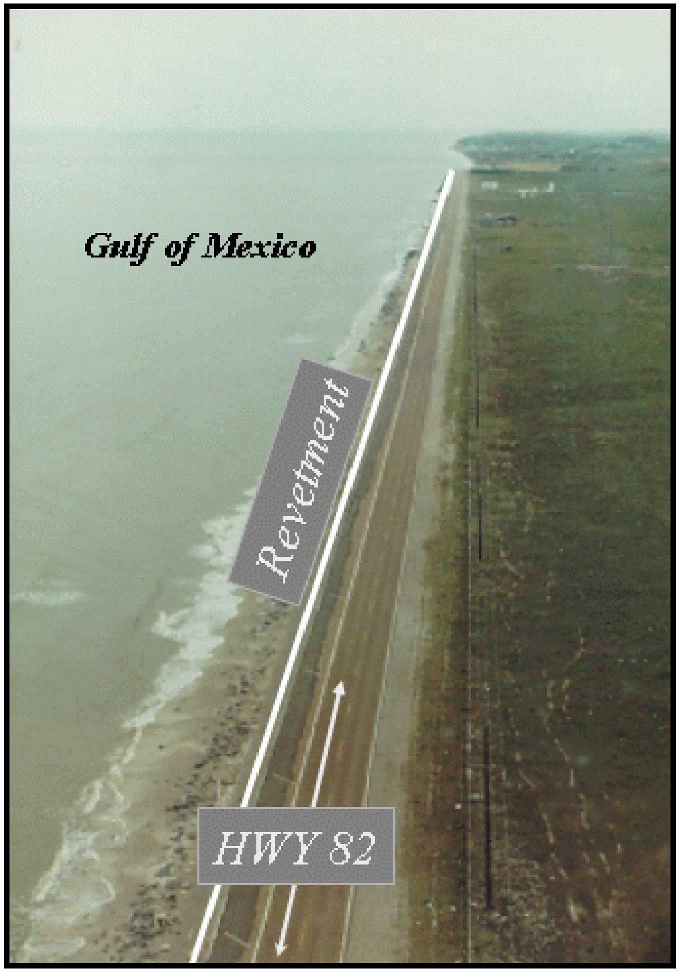

Figure 3. Aerial view of La. Hwy. 82 adjacent to the revetment installed by the La. Dept. of Transportation and Development during the 1970's. Image from Underwood et al. (1999).

Figure 4. Wave over-wash of the La. Hwy. 82 revetment and roadway during an extreme high tide event showing collapse of the embankment and roadbed beneath the westbound lane of the highway. Image from Underwood et al. (1999).

Habitat data for the 1956-1990 time period (USGS-NWRC 2001) indicates a shift to brackish marsh (non-fresh marsh) in project Area A during the 1950's through the 1970's in response to deepening of the Calcasieu Ship Channel and continued channelization in the area, followed by a shift towards intermediate marsh during the 1980's and 1990's as water salinity controls began to mitigate the increased salt water intrusion that resulted from earlier hydrological changes in the area (figure 5). The most significant change in project Area B over this same time period (USGS-NWRC 2001) has been the conversion of marsh and scrub/shrub habitats to agricultural rangeland and the loss of beach habitats as a result of shoreline erosion (figure 6).

Project Goals and Strategies/Coast 2050 Strategies Addressed:

Re-establishing the subaerial and subaqueous beach profile using sediment dredged from near shore and/or offshore regions, will (1) maintain the integrity and functionality of the chenier/beach ridge; (2) reduce over-wash occurrences of the chenier/beach ridge during episodic higher wave energy events in the Gulf of Mexico; (3) provide storm protection to intermediate and brackish marsh habitats north of the chenier/beach ridge (project area A), (4) restore the littoral drift system, thereby reducing down drift erosion rates (project area B); and (5) allow for monitoring and quantification of beach profile changes and beach shape development; resulting in a refining of breakwater design and possible augmentation and/or enhancement of existing breakwaters.

Prior to authorization of construction funds, CWPPRA projects are reviewed for compatibility of project goals with those of the Coast 2050 program (Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority [LCWCRTF and WCRA] 1998), and to assess the probability that the proposed restoration strategies will accomplish those goals.

Project Goals:

1. 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.

2. 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.

Project Strategies:

The following strategies will be used to accomplish the above goals:

1. Modify the design of 18 existing breakwaters (table 2) on the west end of the breakwater field and remove 6 experimental breakwaters located landward of existing breakwaters 35 through 40 (table 2), to enhance their sediment trapping capability.

2. Re-establish a sub-aerial beach profile that will reduce the occurrence of wave over-wash of the chenier/beach ridge.

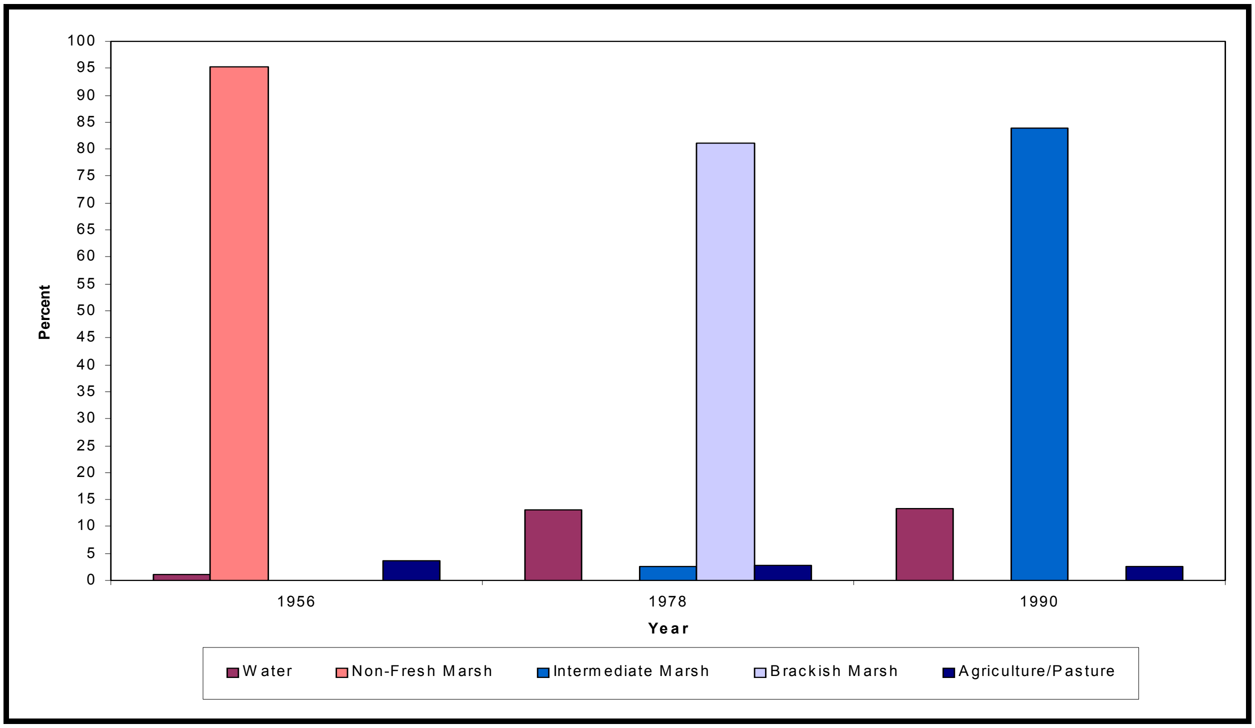

Figure 5. Changes in habitat types (in percent) in the CS-31 project Area A from 1956-1990.

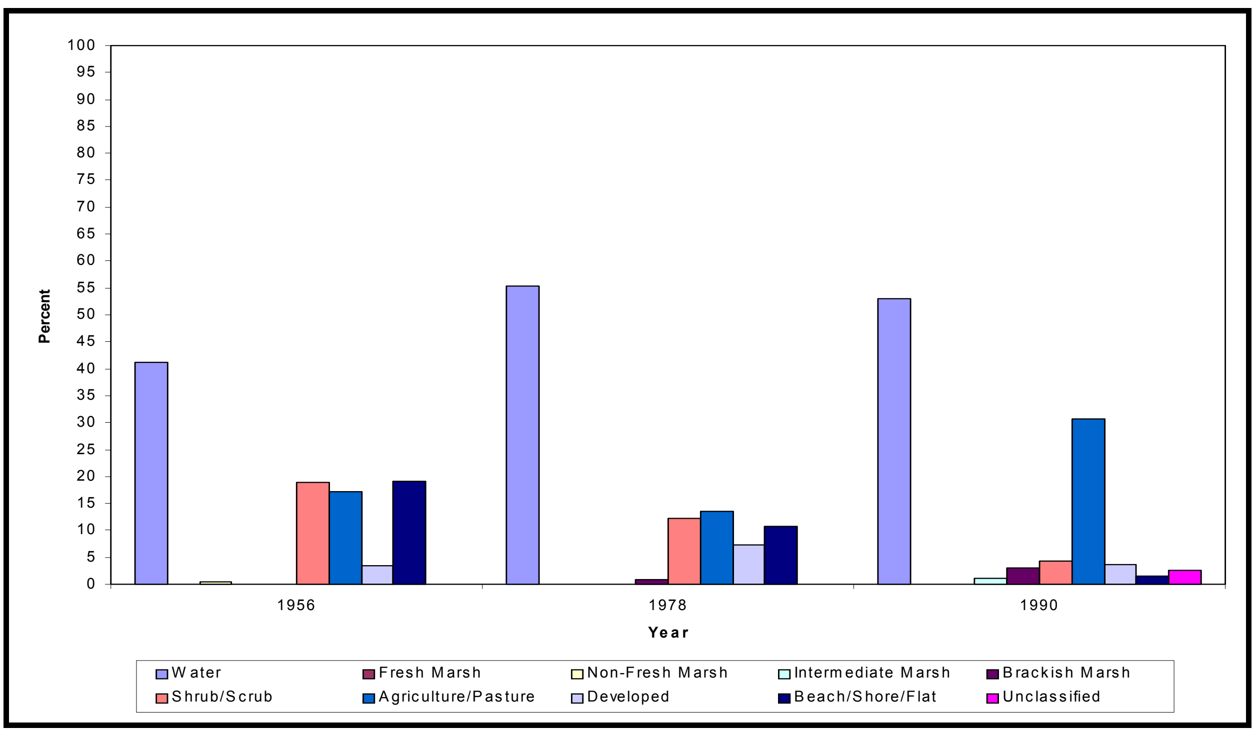

Figure 6. Changes in habitat types (in percent) in the CS-31 project Area B from 1956-1990.

3. Evaluate beach response to nourishment after 2 years to facilitate re-evaluation of the existing breakwater design. (Note: Downdrift of the 18 existing breakwaters to be modified, it will not be possible to determine if changes in beach response are the result of the beach nourishment or the breakwater modifications, or both.)

4. Refine the existing breakwater design and spacing, upgrade and/or repair existing breakwaters in order to enhance sediment trapping and shoreline protection in the project area. Maintain the shoreline position (high water/rack line along beach ridge) seaward of its pre-nourishment position for the first 5 years (for breakwaters 10 thru 72).

5. Maintain shoreline position (high water/rack line along beach ridge) seaward of its original pre-nourishment position for an additional 5 years, should the beach need re-nourishment.

6. Maintain water salinity in the project area north of the beach/ridge within a target range (3-12 ppt) suitable for intermediate and brackish marsh vegetation.

7. Maintain existing intermediate and brackish marsh vegetation in the project area north of chenier/beach ridge.

These project strategies are consistent with the Region 4 habitat objective for the Calcasieu-Sabine Basin, which is to create fresher conditions by the year 2050 (LCWCRTF and WCRA 1998). They are also consistent with the goals of the Coast 2050 regional strategies for Region 4, which are to eliminate adverse hydrological conditions, including elevated water levels and salinity spikes, and to reestablish or maintain the integrity of the major natural land forms (LCWCRTF and WCRA 1998). In particular, this project directly supports the regional strategy of stabilizing the Gulf of Mexico shoreline from Calcasieu Pass to Johnson's Bayou (LCWCRTF and WCRA 1998), which is essentially the southern boundary of the Martin Beach-Ship Canal Shoreline hydrological unit of the Calcasieu-Sabine Basin. Successful implementation of this project will also help to maintain a suitable level of storm surge protection to the adjacent East Johnson's Bayou, Johnson's Bayou Ridge, and Second Bayou hydrological units.

<u>Project Features</u>

The Holly Beach to Constance Beach Segmented Breakwaters Enhancement And Sand Management (CS-31) project design includes several components. First, 18 of the breakwaters on the west end of the breakwater field were modified to improve their effectiveness at trapping sand (table 2). Five were extended, 7 had their crests raised, and 6 were both extended and raised prior to beach establishment. In addition, 6 experimental breakwaters located landward of breakwaters 35 through 40 were removed to improve the effectiveness of breakwaters 35 through 40 at trapping sand (table 2).

Table 2. Breakwater modifications and experimental breakwater removals completed prior to beach nourishment. (Items in **boldface** type will be both raised and extended.)

Breakwater Nos. (W to E)	Modifications
23, 25	Extend 30 ft to east
24	Extend 40 ft to east
19, 21	Extend 50 ft to east
20	Extend 60 ft to east
14, 22	Extend 70 ft
13	Extend 75 ft
12, 15	Extend 80 ft to east
10, 11, **12**, **13**, **14**, **15**, 16, 17, **20**, **23**, 31, 32, 38	Raise crest elevation to 4.0 ft NAVD
35	Remove experimental rubble mound breakwater located landward of breakwater
36, 37, 38, 39, 40	Remove experimental piling and tire breakwater located landward of breakwater

Next, a berm was constructed in shallow water along the beach and sand was pumped in along the shoreline to elevate and prograde the beach seaward. A total of 1,750,000 cubic yards (1,337,967 cubic meters) of coarse sand suitable for shoreline building from an offshore source was pumped into the breakwater field between breakwaters 10 and 72 to increase the amount of sediment available to the littoral transport system in an effort to improve the effectiveness of the breakwater field at trapping sediment and maintaining the shoreline seaward of its position prior to beach nourishment. Two years after the sand-pumping, a professional surveyor will conduct another elevation survey and compare with pre-construction and "as-built" survey data to determine what effect sand nourishment had on the beach profile. This information will be used to refine the existing breakwater design based on shoreline response, and to indicate where modifications and/or repairs are needed on the existing breakwaters.

In addition, sand fencing and vegetation is being placed along the Holly Beach shoreline to stabilize the constructed dune. Approximately 18,400 transplants of *Panicum amarum* (Bitter Panicum) will be planted on five-foot centers along approximately 28,000 linear feet (8,534 m) of dune. The entire length of the dune is presently being constructed with sand fencing and shall be planted with four rows of *P. amarum* (2 rows on either side of the fence). Rows will be spaced 10 ft (3.05 m) apart and will be planted along approximately the center line of the dune.

The total amount of sand pumped in was based on estimates of the quantity of sand needed to maintain the beach seaward of its pre-nourishment position for 10 years. If supported by analysis of the elevation surveys conducted during years 0 and 2, an additional survey may be needed at year 5 to determine if additional sand nourishment is needed to meet the 10-year design plan.

Monitoring Goals

Priorities:

Although classified as a shoreline protection project, the Holly Beach to Constance Beach Segmented Breakwaters Enhancement and Sand Management (CS-31) project is also expected to provide surge protection to adjacent wetlands to the north, as well as to the local socio-economic infrastructure. It also will help maintain intermediate marsh conditions and the present land:water ratio in wetlands north of the beach ridge/highway embankment.

Because this project is inherently experimental in design and all anticipated benefits are dependent upon the success of re-establishing an adequate beach profile, pre- and post-construction monitoring of the sub-aerial beach is the most critical monitoring effort. This task will fall under Operations & Maintenance (O & M) of the project. All surveys required to evaluate the sub-aerial beach profile will be conducted and analyzed by an engineering consultant firm on contract with LDNR. Also, downdrift of the 18 existing breakwaters to be modified, it will not be possible to determine if changes in beach response are the result of the beach nourishment, the breakwater modifications, or both. The Coastal Restoration Division (CRD) monitoring section will focus on evaluating project effects on shoreline position, the natural emergent wetland vegetation, the vegetative plantings and water salinity.

Specific Monitoring Goals:

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. (This will be done by a professional Engineering firm, see note 6).

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 thru 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 for effects of over-wash occurrences.

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

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

Reference Area:

An effective way to evaluate project success is to monitor the project area and a reference area to provide a means to achieve statistically valid comparisons. Based on similarities in soil type, vegetation community, and hydrology, the area west of the project area was considered as a possible reference site. However, west of the project area, the shoreline extends further to the south while the La. Hwy. 82 embankment continues west, becoming more distant from the shoreline. Although the soils and marsh community north of this segment of the highway are similar to that of the project area, wave over-wash is not occurring here and erosion of the chenier ridge/highway embankment is not imminent. Recent geomorphic studies show that the shoreline west of the project area is prograding while the project area shoreline is in retreat (Byrnes and McBride 1995). This area is influenced by the Sabine Pass jetties, which promote deposition eastward along the shoreline between the project area and the jetties (McBride and Byrnes 1995). The addition of sand into the breakwater field is also expected to increase deposition westward since more material will be available for the littoral transport system. These differences preclude using the shoreline and marsh west of the project area as a reference site. Given the unique environmental conditions present at Holly Beach, it is unlikely that a suitable reference site can be found elsewhere and thus, evaluations of project effectiveness will be limited to comparisons with historical rates of shoreline movement within the project area.

CRMS will provide a pool of reference sites within the same basin and across the coast to evaluate project effects. At a minimum, every project will benefit from basin-level satellite imagery and land:water analysis every 3 years, and supplemental vegetation data collected through the periodic Chabreck and Linscombe surveys. Other CRMS parameters which may serve as reference include Surface Elevation Table (SET) data, accretion (measured with feldspar), hourly water level and salinity, and vegetation sampling. A number of CRMS stations are available for each habitat type within each hydrologic basin to supplement project-specific reference area limitations.

Monitoring Strategies

The following monitoring elements will provide the information necessary to evaluate the specific monitoring goals listed above:

1. Aerial Photography — To measure marsh and open water areas color-infrared aerial photography (1:12,000) will be acquired. The photography will be georectified using standard procedures as outlined in Steyer et al. (1995, revised 2000), and land:water ratios will be determined. The pre-construction photography was obtained in December 2001 (charged to project planning) and December 2002. Photography will also be obtained in post-construction year 3 in 2005 and year 7 in 2009. Additional photography may be obtained in response to storm events.

2. Bathymetry/Topography — To document both horizontal and vertical change along the project area shoreline, transect lines used to measure elevation will be established parallel and perpendicular to the breakwaters, and tied in to a known elevation datum by professional surveyors. These transect lines will be surveyed once pre-construction, immediately post-construction in 2003 and again in 2005. (This item will be funded through the construction and O&M budget, not through the monitoring budget.)

3. Vegetative Plantings — The general condition of the *P. amarum* plantings will be documented using a generally accepted methodology similar to Mendelssohn and Hester (1988), <u>Coastal Vegetation Project, Timbalier Island</u>. Plots will be chosen by randomly selecting numbers based on the coordinates within the project area to represent a 10 percent sample of the plantings. The GPS coordinates will be 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 will also be recorded for each plot. The percent cover for each plot will be broken down into the percent cover provided by the *P. amarum* plantings, by other wetland species and by upland species. These criteria will be documented in the fall of 2003, the spring of 2004 and the fall of 2004 or until the original plants become indistinguishable. The possibility of herbivore damage is recognized and will be recorded if observed.

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

5. Water Salinity — To assist in determining the frequency that high salinity water enters the interior marsh from wave over-wash, three continuous recorders will be installed to collect hourly salinity data, one at the southern end of Cowboy Ditch adjacent to the low section of La. Hwy. 82 with concrete block revetment between Peveto Beach and Holly Beach, one in a marsh pond on the west side of the project area, and one in

a marsh pond on the east side of the project area (figure 1). 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. Hourly water salinity will be collected at these three stations from September 2002 through 2004.

6. Emergent Vegetation — To document the condition of the emergent vegetation in the project area over the life of the project, vegetation will be monitored at 20 to 30 sampling stations established along transect lines within the project area. Using the Braun-Blanquet methodology outlined in Steyer et al. (1995), percent cover, species composition, and dominant plant height will be documented in replicate 2 m by 2 m sampling plots established at each station. A pole installed in one corner of each plot will allow for locating and reevaluating established plots over time. Descriptive observations of SAV will be noted during monitoring of emergent vegetation. Vegetation will be monitored once pre-construction in 2002 and again in 2003, 2004, 2005, and 2009.

<u>Anticipated Statistical Tests and Hypotheses</u>:

The following hypotheses will be used to evaluate the accomplishment of the project goals.

1. <u>Aerial Photography</u>. Descriptive and summary statistics on historical data (for 1956, 1978, 1988, and 2001) and data from color-infrared aerial photography collected immediately post-construction and later will be used, along with GIS interpretations of these data sets, to evaluate marsh to open water ratios.

   Goals: Maintain land-water ratio in intermediate and brackish marshes north of the chenier/beach ridge.

2. <u>Bathymetry/Topography</u>. These data will be used to construct both horizontal and vertical beach profiles pre- and post-construction. Differences in profiles will show changes in beach width and sand volume due to the project construction and over time.

   Goals: Re-establish a sub-aerial beach profile that will reduce occurrence of wave over-wash of the chenier/beach ridge.

   Evaluate beach response to nourishment and breakwater modifications after 2 years to facilitate re-evaluation of existing breakwater design.

3. Vegetative Plantings. The success of the *P. amarum* plantings will be determined by analysis of descriptive statistics. These elements will be examined utilizing ANOVA's to monitor the success or failure of the plantings. If monitoring results fail to reject the null hypothesis, project effects will be investigated.

Goal: Increase vegetative cover.

Hypothesis:

H_o: Post-planting vegetative cover along the shoreline at time point i+1 will not be more than vegetative cover at time i.

Ha: Post-planting vegetative cover along the shoreline at time point i+1 will be more than vegetative cover at time i.

4. Shoreline Change. Shoreline position will be mapped using DGPS and the total acres gained or lost along the project area shoreline will be calculated.

Goal: Maintain the shoreline position seaward of its pre-nourishment position.

5. Water Salinity. Water salinity measurements will be used as a substitute for direct measurement of over-wash events. A maximum salinity range will be determined for normal hydrologic conditions within project Area A. Frequency and severity of salinity spikes will be documented and related to storm events or other possible causes. Comparisons will be made 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 determine the origin of high salinity water that may enter the project area during storm events.

Goal: Reduce the occurrence of over-wash of the chenier/beach ridge during episodic higher wave energy events in the Gulf of Mexico.

6. Emergent Vegetation. Appropriate parametric or non-parametric statistical test will be used to determine changes in the occurrence and cover of intermediate and brackish marsh vegetation in the project area north of the chenier/beach ridge (Area A) over time.

Goal: Maintain existing intermediate and brackish marsh vegetation in the project area north of the chenier/beach ridge (Area A).

Hypothesis:

H_0: Mean % occurrence and mean % cover of intermediate and brackish marsh vegetative species within the project area (Area A) after construction will not be significantly less than before construction.

H_a: Mean % occurrence and mean % cover of intermediate and brackish marsh vegetative species within the project area (Area A) after construction will be significantly less than before construction.

Notes

1. Implementation:

	Start Construction:	June 2002
	End Construction:	February 2003
	Sand fencing:	Spring 2003
	Vegetative Plantings:	Fall 2003

2. NRCS Point of Contact: Marty Floyd (337) 473-7690

3.

LDNR Project Manager:	Ismail Merhi	(225) 342-4127
LDNR Monitoring Manager:	Mark Mouledous	(337) 482-0661
LDNR RTS Manager:	Kyle Balkum	(225) 342-9429

4. The twenty-year monitoring plan development and implementation budget for this project is currently $578,707, of which $352,000 will fund the first 2 bathymetric/topographic surveys to be conducted by a professional survey firm. These data will be used to evaluate the response of the initial beach nourishment and evaluate the need for refurbishing breakwaters or additional sand nourishment. Project-specific reports will be available in 2003-2007, the elevation survey report will be available from the engineering firm on contract after surveys are completed and analyzed in 2004, and periodic basin-wide comprehensive reports will be completed. These reports will describe the status and effectiveness of the project.

5. Pre-construction photography and land:water analysis was paid for with project planning funds so it is not included in the monitoring budget.

6. Over-wash events have been predicted based on offshore WIS station G1073, wave height, and pre-construction beach profile. An average of 82 overtopping events per year was estimated, and an overtopping event occurs when a wave height of 5.7 ft is recorded at the WIS station, traveling to approximately 4.0 feet at the toe of the breakwater. It is anticipated that the number of over-wash events will be dramatically reduced and that a 4.0-ft wave height at the toe of the breakwater will no longer result in overtopping. The frequency of overtopping events will be determined utilizing direct measurement of salinity on the north side of the chenier ridge, adjacent to the area most vulnerable to over-wash (i.e., the reach of shoreline between Peveto Beach and Holly Beach adjacent to the section of La. Hwy. 82 with concrete block revetment.)

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