MONITORING PLAN

PROJECT NO. ME-16 (PME 7-a) FRESHWATER INTRODUCTION SOUTH OF HWY 82

DATE: May 10, 2005

Project Description

The Freshwater Introduction South of Hwy. 82 project was proposed on the 9th priority list of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The project area is located in the central and eastern portions of Rockefeller State Wildlife Refuge, on the eastern end of the Grand Chenier ridge, approximately 10 miles (16.09 km) east of the community of Grand Chenier in Cameron and Vermilion Parishes, La (figure 1). It is bounded to the west by a canal west of Little Constance Bayou south of Deep Lake, to the south by the Gulf shoreline of the unmanaged marsh south of Unit 6, to the east by Rollover Bayou to a line from Flat Lake to the western boundary of Unit 15 and to the north by Louisiana Hwy. 82. The project will benefit some 19,988 acres (8,088.87 ha) of which 15,835 acres (6,408.21 ha) are marsh and the remaining 4,153 acres (1,680.66 ha) are open water (Clark 1999).

The "Lakes" subbasin of the Mermentau Basin is experiencing high water levels (>2 ft MLG) due to the existence of locks and gates to control water levels and prevent saltwater intrusion into Grand and White Lakes. The Chenier subbasin of the Mermentau Basin is experiencing saltwater intrusion due to lack of freshwater flow caused by the presence of the hydrologic barriers consisting of Hwy. 82 and the Lakes subbasin gates and locks. Marsh loss is occurring in the Chenier subbasin due to saltwater intrusion and in the Lakes subbasin due to high freshwater water levels which stress *Spartina patens* (marshhay cordgrass) and certain fresh marsh species and cause increased shoreline erosion along White Lake and Grand Lake (Clark 1999).

Most of the soils in the project area are classified as either Clovelly muck, Scatlake mucky clay or Bancker muck, which are level, poorly drained fluid soils (U.S. Department of Agriculture [USDA] 1995). Clovelly muck and Bancker muck are organic and mineral soils respectively, found in brackish marsh, whereas Scatlake mucky clay, prevalent at the southern end of the project area, is a mineral soil found in saline marshes.

The habitats of primary importance in the project and adjacent areas are brackish and intermediate emergent marsh with saline marsh along the edge of the Gulf of Mexico (Chabreck et al., 1968, Chabreck and Linscombe, 1978, 1988). Dominant emergent vegetation species present in and adjacent to the project include *Spartina patens* (marshhay cordgrass), *Schoenoplectus americanus* (chairmaker's bullrush), *Distichlis spicata* (inland saltgrass), *Phragmites australis* (Roseau cane) and *Schoenoplectus robustus* (leafy three-square) (USDA-NRCS 2002).

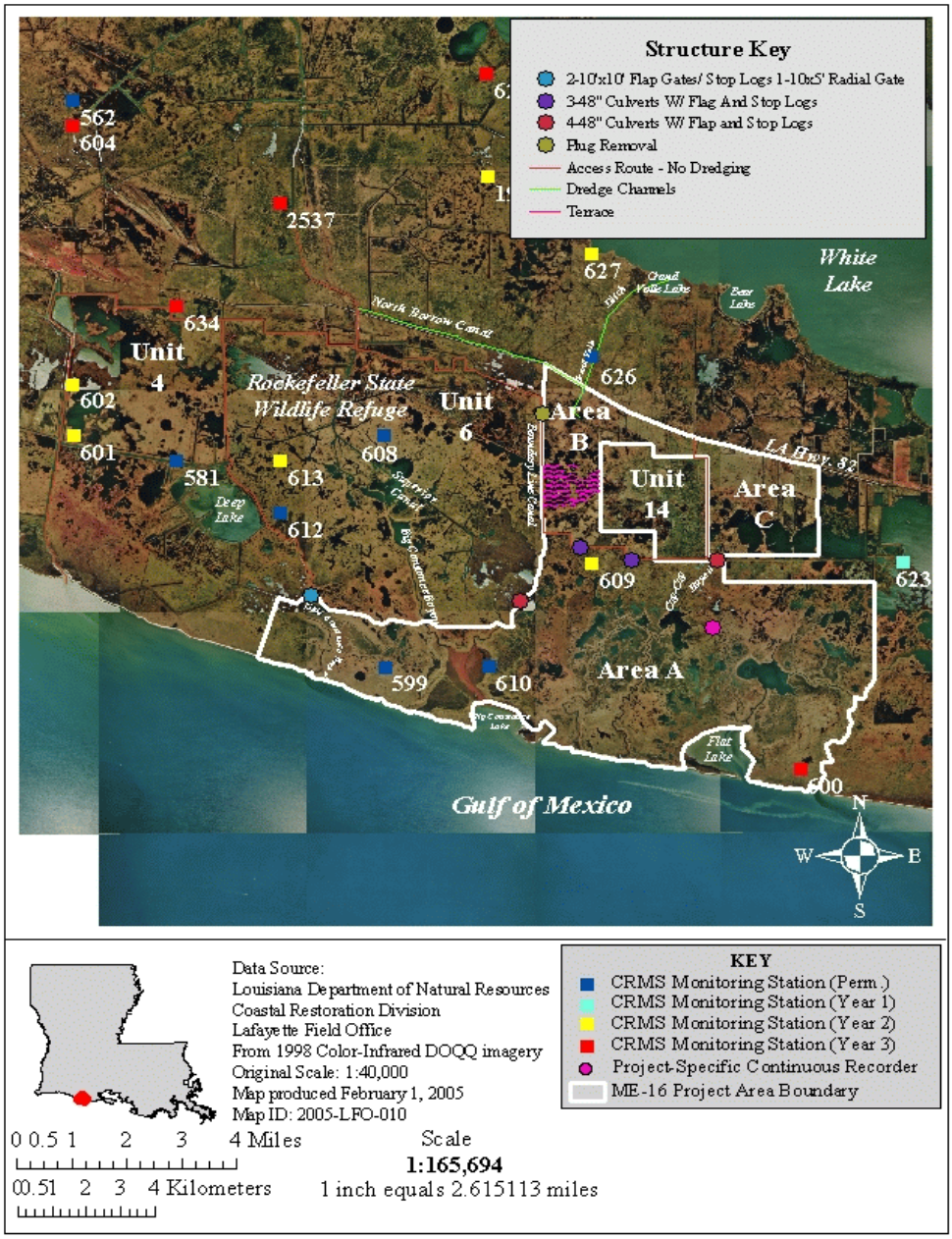

Figure 1. Freshwater Introduction south of Hwy. 82 (ME-16) project area features and CRMS-*Wetlands* stations within the project area and surrounding marsh.

The project is co-sponsored by the United States Fish and Wildlife Service (USFWS) and the Louisiana Department of Natural Resources (LDNR) and it proposes to gravitationally move water from Grand and White Lakes (when adequate head differential exists) to marsh areas south of Hwy. 82, in order to moderate elevated salinities in the project area, and will create 14 acres (5.67 ha) of marsh through the construction of terraces.

A model was prepared by Fenstermaker and Associates and a report was submitted to evaluate the effects of the project (C.H. Fenstermaker and Associates [CHFA] 2003). The modeling software used was MIKE 11, a one-dimensional model used for simulating flows, sediment transport, and water quality in estuaries, rivers, irrigation systems, and similar water bodies. The model showed that, overall, the project would reduce salinities in Area A. The magnitude of salinity reduction varied from each location with variances from 1-2 ppt to 3-4 ppt. With a careful management plan for the operation of the flap gates of the proposed structures, the project is not expected to deteriorate the salinity regime of Unit 4. These flap gates should also protect Unit 4 from salinity spikes.

Project Goals and Strategies/Coast 2050 Strategies Addressed

CWPPRA projects are reviewed prior to authorization of construction funds for compatibility of project goals with those in Coast 2050 (Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority [LCWCRTF & WCRA] 1998), and for the probability that proposed restoration strategies will accomplish those goals. Moving water from the Lakes Subbasin across Hwy. 82 is a Coast 2050 "Regional Ecosystem Strategy"to restore the natural hydrology and minimize salt water intrusion (LCWCRTF & WCRA 1998). Terracing is a "Coastwide Common Strategy" of the Coast 2050 plan that will be used and evaluated in this project. If the constructed terraces retain adequate amounts of sediment, then the vertical accumulation of those sediments should contribute to the sustainability of the wetlands. Sustained SAV growth, due to the reduction of turbidity, should improve system linkages, another important strategic goal of the Coast 2050 plan (Balkum 2000).

Project goals and strategies for the Freshwater Introduction South of Hwy 82 project were provided by the USFWS (1999) through the Environmental Assessment (EA) and/or Wetland Value Assessment (WVA) for the project.

Project Goals:

1) Protect and restore intermediate and brackish marshes within the project area over the 20-year project life.

Project Strategies:

1) Introduce fresh water from north to south across Hwy 82, via channel improvements and water control structures to reduce salinities and increase SAV's within Areas A, B, and C.
2) Construct earthen terraces in open water areas of Area B to reduce fetch and wave energy, retain sediments and maintain SAV habitat.

Project Features

The project construction phase consists of the following components:

1) Louisiana Highway 82 Channel Enlargement - Widen and deepen the existing 8 ft (2.44 m)-wide X 1 ft (0.31 m)-deep trenasse connecting Superior Canal to the LA Highway 82 Northern Borrow Canal to 20 ft (6.10 m) bottom width, 44 ft (13.41 m) top width x 4 ft (1.22 m)-deep. Enlarge the LA Highway 82 Northern Borrow Canal to 44 ft (13.41 m) top width X 4 ft (1.22 m)-deep X 13,565 ft (4,134.61 m)-long. Native material will be removed from the borrow canal water bottom via bucket or spray dredge and thinly spread to 10 in (25.4 cm) high or less in adjacent marsh in 500 ft (152.4)-long lengths, 100 ft (30.48)-wide, with 50 ft (15.24) gaps between each segment.

2) Grand Volle North Channel Enlargement and Barricade Construction -

   2a. Grand Volle Ditch to Grand Volle Lake Enlargement - Widen and deepen 12,650 linear ft (3,855.72 m) of the Grand Volle Canal on the north side of LA Highway 82 from 10 ft (3.05)-wide X 1 to 2 ft (0.31 to 0.61 m)-deep to 4 ft (1.22 m) bottom width, 28 ft (8.53 m) top width X 4 ft (1.22 m) deep, 3:1 side slopes. Native material will be removed from the water bottom and adjacent marsh by bucket or spray dredge and thinly spread to 10 in (25.4 cm) high or less in adjacent marsh in 60 ft (18.29)-wide by 500 ft (152.4 m) lengths staggered on each side of the channel.

   2b. Grand Volle Lake Channel Enlargement and Terrace/ or Rock Placement - Construct a 2,441 linear-ft (744.01 m) X 25 ft (7.62)-wide X 2 ft (0.61 m)-deep conveyance channel in open water bottoms in Grand Volle Lake via bucket or spray dredge. Construct 4,882 linear ft (1,488.03 m) of vegetated earthen terraces to reduce sedimentation and restore marsh. The upper surfaces of the terraces will be planted with wetland vegetation. Transport approximately 3,333 cubic yards (2,548.26 cubic meters) of rock and place along Grand Volle Lake channel to reduce channel sedimentation if necessary.

   2c. Barricade Construction - A 100 ft (30.48 m)-long timber barricade with 12 in (30.48 cm) diameter timber piles placed at 10 ft (3.05 m) intervals with three horizontal whalers will be constructed at the intersection of the Grand Volle Ditch and Grand Volle Lake. There is no existing navigable connection between Grand Volle Ditch and Grand Volle Lake.

3) Grand Volle South Channel Enlargement - Deepen the existing Grand Volle Canal channel on the south side of Louisiana Highway 82 from 50 to 60 ft (15.24 to 18.29 m)-wide X 1 to 2 ft (0.31 to 0.61 m)-deep to 4 ft (1.22 m) bottom width, 28 ft (8.53 m) top width X 4 ft (1.22 m) deep, 3:1 side slopes by 3,400 ft (1,036.32 m)-long. Native material will be removed from the water bottom via bucket or spray dredge and thinly spread to 10 in (25.4 cm) high or less in adjacent marsh and open water in 60 ft (18.29 m)-wide by 500 ft (152.4 m) lengths staggered on each side of the channel. **Note:** Spoil for the above channel enlargements will be removed from the water bottom and conveyed to the spoil disposal area using a spray dredge if funds are available. If not, the spoil will be thinly spread by bucket no higher than 10 in (25.4) over marsh to reduce wetland impacts. Both spray and thin-spread dredging and spoil placement techniques will impact less marsh than conventional bucket dredging techniques.

4) Earthen Terraces - Approximately 26,000 linear ft (7,924.8 m) of 1,000 ft (304.8 m)-long by 36 ft (10.97 m)-wide vegetated "duck-wing" shaped earthen terraces will be placed in shallow open water between Units 6 and 14 using a bucket dredge. Terrace rows will be 500 ft (152.4 m) apart, terrace segments will have 100 ft (30.48 m) gaps between segments, and terrace tops will be 10 ft (3.05 m) wide. The upper surface of terraces will be planted with wetland vegetation.

5) Removal of Borrow Line Canal Earthen Plug - Remove the existing plug in the Superior Canal branch that forms the eastern boundary of Rockefeller Refuge Unit 13 at the NE portion of Unit 13/ Unit 6 Boundary Line Canal.

6) Little Constance Structure Alteration - On the existing 3-bay radial arm gate structure, 2 - 10 ft (3.05 m) X 10ft (3.05 m) radial arm gates will be replaced with 4 - 4'-8" (1.42 m) X 6'-8" (2.03 m) flap gates on the south side and stop logs [10 ft (3.05 m) wide] on the north side to allow fresh water to flow southward when conditions permit. The existing Little Constance and Big Constance Bayou water control structure operation plan will remain the same.

7) New Dyson Structure - Install a new structure with four 48 in (121.92 cm) diameter culverts with flapgates and stoplogs north of the existing Dyson Bayou structure near the NW portion of a small lake in the Unit 6 eastern Boundary Line levee.

8) New Cop Cop Structure - Install a new structure with four 48 in (121.92 cm) diameter culverts with flapgates and stoplogs near the plugged Cop Cop Bayou adjacent to the existing Cop Cop Bayou structure.

9) Structure No. 10 - Install a new structure with three 48 in (121.92 cm) diameter culverts with flapgates and stoplogs in the Boundary Line Levee south of Unit 14.

10) Structure No. 12 - Install a new structure with three 48 in (121.92 cm) diameter culverts with flapgates and stoplogs in the Boundary Line Levee south of Unit 14.

11) Boundary Line Channel Enlargement - Deepen the existing 60 ft (18.29 m) X 1 ft (0.31 m) deep boundary line channel near the Cameron-Vermilion Parish line to 13,850 ft (4,221.48 m) long X 30 ft (9.14 m) wide by 5 ft (1.52 m) deep. Approximately 40,000 cubic yards (30,582.19 cubic meters) of water bottom will be excavated and discharged on the adjacent upland spoil levee.

Monitoring Goals

CWPPRA projects authorized for construction after August 14, 2003 will be monitored only with CRMS-*Wetlands* stations and other existing data collection. At the request of the federal sponsor (USFWS) one additional continuous recorder was specifically added to the project and will be funded through project-specific monitoring funds. There are 4 CRMS-*Wetlands* sites in the project area: 599 and 610 are permanent stations, 609 is a year 2 station, and 600 is a year 3 station (figure 1). Five Chabreck-Linscombe transects cross the project area placing 8 points inside where vegetation type is determined.

Priorities:

The ME-16 project is classified as a freshwater introduction project. The improvement of channels and installation of structures are expected to increase freshwater flow from the Lakes subbasin into the project area. The construction of terraces may also reduce turbidity within the project area by causing suspended sediments to fall out of the water column. Basin-level satellite imagery will be used to document land/water ratios for the entire project area, and color-infrared aerial photography will be used to document land-water changes around the CRMS-*Wetlands* sites. O&M inspections of the terraces will be used to determine if additional marsh habitat has been created and will include ocular estimates of vegetative cover, composition, and how well the plantings survived or spread.

Specific Monitoring Goals:

1) Reduce the rate of marsh loss in Area A saline marshes from 0.16%/yr to 0.11%/yr, in Area A brackish marshes from 0.16%/yr to 0.10%yr, in Area B marshes from 0.24%/yr to 0%/yr and Area C marshes from 0.56%/yr to 0.39%/yr.
2) Reduce mean salinity levels in Area A saline marshes from 20 ppt to 17 ppt, in Area A brackish marshes from 15 ppt to 11 ppt, and in Areas B and C, from 5 to 4 ppt..
3) Increase the coverage of emergent wetland vegetation within the project area.
4) Increase the coverage of submerged aquatic vegetation (SAV) in the shallow open water areas within the project area.

Reference Area:

Collecting monitoring data on both project and reference areas provides a way to achieve statistically valid comparisons, and thus a reliable evaluation of project effectiveness. Due to increasing difficulty of finding adequate reference areas for CWPPRA projects, one intent of the CRMS-*Wetlands* is to provide a suite of reference stations to be used for this purpose. There are no reference areas useful to evaluate specific monitoring goal 4. We can only compare our observations on this project with those on similar projects. A large number of CRMS-*Wetlands* sites located in similar marsh types as project area stations may be used as reference areas for evaluating land-water ratios, water levels, mean salinity levels, and vegetation cover.

Monitoring Strategies

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

CRMS-*Wetlands* Strategies

1.	Spatial Data	Aerial photography and satellite imagery will be collected for the entire coast through CRMS-*Wetlands*. The satellite imagery will be analyzed to determine land and water areas for the entire coast. This imagery will be subset and used to qualitatively evaluate changes in land and water areas within the ME-16 project area at a coarse (25m) resolution. Photography and satellite imagery for the Mermentau Basin will be collected and analyzed for years 2005, 2008 and every 3 years thereafter.

2. Salinity — Salinities will be monitored hourly utilizing 4 CRMS-*Wetlands* stations. Marsh-water salinity will be measured every hour with a salinity gauge that is attached to the water-level gauge. The gauges will be serviced at the same time. Continuous data will be used to characterize average annual salinities throughout the project and reference areas. At each servicing, a measurement of interstitial water salinity will be made adjacent to each gauge. Interstitial water salinity will be determined at each vegetation plot, when vegetation is surveyed. In addition, a project-specific continuous recorder will be installed within a bayou southeast of Cop Cop Bayou to further measure project effects on marsh-water salinity levels.

3. Water Level — Water level within the marsh will be measured every hour with a water-level gauge installed within an area that is hydrologically connected to the surrounding water body. The gauge will be surveyed relative to the top of the SET (NAVD 88). The water-level gauge will be serviced on approximately a monthly basis. Duration and frequency of flooding will be calculated based on the average elevation of the marsh surface and water level to look at vegetative health.

4. Vegetation — Vegetation composition and cover will be estimated from 10 permanent 2x2 m plots that are randomly distributed along a transect in the emergent marsh within each of the 1 km^2 CRMS-*Wetlands* sites. Data will be collected in early fall and will follow the Braun Blanquet method.

Project Specific Strategies:

1. Vegetation: The condition of natural and planted vegetation on the terraces will be qualitatively evaluated using ocular cover estimates, hand held digital photography, and species composition determination to coincide with annual inspections conducted with CED personnel.

Anticipated Statistical Analyses and Hypotheses

The following hypotheses correspond with the monitoring elements and will be used to evaluate the accomplishment of the project goals.

1. Land/Water Ratio:

Descriptive and summary statistics on historical data, as part of the CRMS-*Wetlands* strategy (for 1956, 1978, 1988, and for any subsequent years) and basin-level data from aerial photography and/or digital satellite imagery collected pre- and post-construction will be used, along with GIS interpretation of these data sets, to evaluate marsh to open water ratios and changes in the rate of marsh loss/gain in the project area.

Goal: Decrease the rate of marsh loss in the project area.

2. Salinity: Descriptive statistics will be used to determine whether target salinities are being met: Target salinities are as follows: Area A saline marshes = 17 ppt; Area A brackish marshes = 11 ppt; Areas B and C = 4 ppt. Target salinities represent monthly salinities. Ancillary data will be used when available.

Goal: Reduce mean salinity levels within the project area to target ranges.

Hypothesis 1:

H_o: Mean salinity in the project area will not be lower than in the reference area post-construction.

H_a: Mean salinity in the project area will be lower than in the reference area post-construction.

Hypothesis 2:

H_o: Mean salinity in the project area post-construction will not be lower than pre-construction.

H_a: Mean salinity in the project area post-construction will be lower than pre-construction.

3. Vegetation: Appropriate parametric and/or nonparametric methods will be used to test the following hypotheses. Ancillary data will be used when available.

Goal: Increase the occurrence (coverage) of emergent marsh vegetation in the project area after construction.

Hypothesis 1:

H_o: Occurrence of emergent marsh vegetation within the project area post-construction will not be significantly greater than the occurrence of emergent marsh vegetation in the reference area post-construction.

H_a: Occurrence of emergent marsh vegetation within the project area post-construction will be significantly greater than the occurrence of emergent marsh vegetation in the reference area post-construction.

Hypothesis 2:

H_o: Occurrence of emergent marsh vegetation within the project area post-construction will not be significantly greater than the occurrence of emergent marsh vegetation within the project area pre-construction.

H_a: Occurrence of emergent marsh vegetation within the project area post-construction will be significantly greater than the occurrence of emergent marsh vegetation within the project area pre-construction.

NOTE: Available ecological data, including both descriptive and quantitative data, will be evaluated in concert with the statistical analyses of all of the above data to aid in

determination of overall project effectiveness. This includes ancillary data collected in the monitoring project but not used directly in statistical analysis, as well as data available from other sources (USACE, USFWS, USGS, LSU, DNR, etc.).

Notes

1.	Proposed Implementation:	Start Construction: End Construction:	June 2005 November 2005
2.	USFWS Point of Contact:	Darryl Clark	(337) 291-3111
3.	DNR Project Manager: DNR Monitoring Manager: DNR RTS Manager:	Ralph Libersat Mark Mouledous Karim Belhadjali	(225) 342-6884 (337) 898-1151 (225) 342-4123

4. Periodic Operations, Maintenance, and Monitoring reports will describe the status and effectiveness of the project.

5. LDNR and LWF collected hourly continuous salinity and water level data within the project and reference areas from May 2001 to April 2004 to obtain preconstruction/modeling data.

6. Existing structures in Unit 6 are operated to maintain a 10 ppt salinity target at the Superior Canal bridge. The current salinity target for Areas B and C is 6 ppt. The water level target for Unit 6 and Areas B and C is 3 inches below marsh water level. All new structures will be operated as freshwater flow structures only and will be operated with flapgates in the down position when necessary to prevent higher salinity water from moving northward. When water level targets aren't exceeded, all stop logs at the Little Constance Bayou Control structure will be removed (see Structure Operation Plan).

7. Although SAV is an important factor within the WVA and the goals of the project, funding restraints do not allow for SAV monitoring. Similar to the project specific strategies for emergent vegetation, ocular estimates during field surveys will be used to document the presence and condition of SAV.

8. Structure operations will be performed by Rockefeller State Wildlife Refuge personnel.

9. References:

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