E C O L O G I C A L R E V I E W

Mandalay Bank Protection (Demonstration)
CWPPRA Priority Project List 9
State No. TE-41, Federal No. XTE-DEMO

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This document reflects the project design as of the 95% Design Review meeting, incorporates all comments and recommendations received following the meeting, and is current as of July 2002.

ECOLOGICAL REVIEW

Mandalay Bank Protection (Demonstration)

In August 2000, the Louisiana Department of Natural Resources (LDNR) initiated the Ecological Review to improve the likelihood of restoration project success. This is a process whereby each restoration project's biotic benefits, goals, and strategies are evaluated prior to granting construction authorization. This evaluation utilizes monitoring and engineering information, as well as applicable scientific literature, to assess whether or not, and to what degree, the proposed project features will cause the desired ecological response.

I. Introduction

The purpose for Mandalay Bank Protection (Demonstration) (TE-41) project is to develop alternative shoreline protection techniques which are better suited for construction on highly erodible organic soils as compared to previous techniques (e.g. rock breakwaters). The proposed project is located along the banks of the Gulf Intracoastal Waterway (GIWW) approximately four miles west of Houma, LA (see Figure 1). The following four shoreline protection techniques will be tested: 1) fiberglass sheet pile, 2) a concrete revetment mat system, 3) A-Jacks® and vegetation plantings, and 4) timber fencing and vegetation plantings. The fiberglass sheet pile and concrete revetment mat system will be constructed in the blowout treatment while the A-Jacks® and timber fencing techniques will be constructed in the off-bank treatment. The experimental design is intended to provide for statistical comparison between the four shoreline protection techniques and their respective controls.

Although the Mandalay Bank Protection project is a relatively small-scale, short-term project compared to other Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects, this demonstration will allow for a scientific evaluation of the effectiveness of four innovative shoreline protection techniques. The results from the experiment will ultimately provide valuable information for the future design of large-scale navigation channel bank stabilization projects such as those identified by Coast 2050 as a Region 3, Regional Ecosystem Strategy and a GIWW Mapping Unit Strategy [Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority (LCWCRTF & WCRA) 1998, LCWCRTF & WCRA 1999].

II. Goal Statement

The biotic goals of this project are:

- to stop shoreline erosion in specified areas along the southern shore of the GIWW,
- to maintain/increase the frequency of occurrence of submersed aquatic vegetation (SAV) within shallow, open-water blowouts along the GIWW,
- to increase mean cover of emergent vegetation in areas adjacent to blow-out sites, and increase mean cover of *Zizaniopsis miliacea* (giant cutgrass) in areas adjacent to off-bank treatments, and
- to increase sedimentation in shallow, open-water blowouts along the GIWW.

The abiotic goal of this project is:

- to statistically test effectiveness of four shoreline protection techniques.

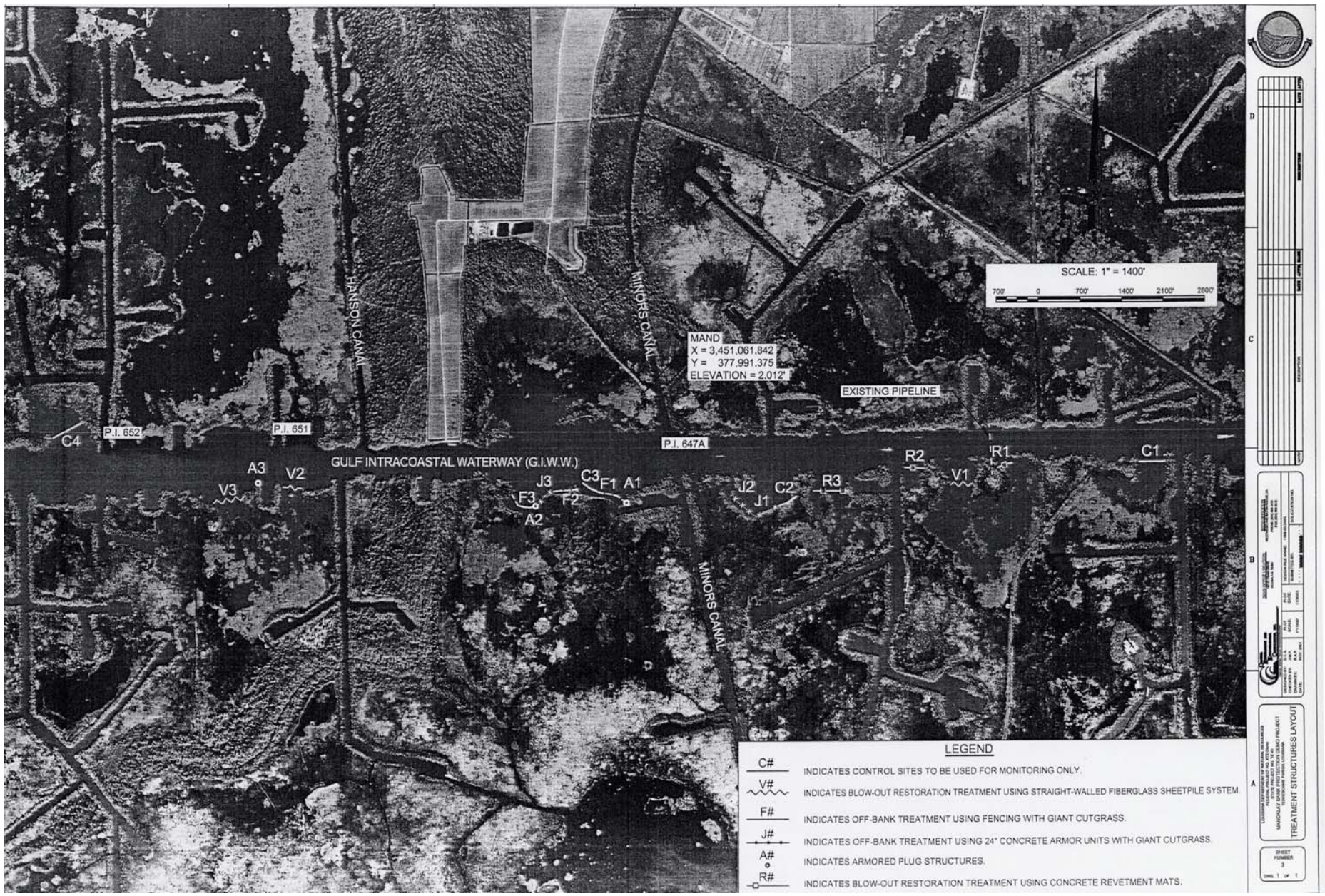

Figure 1. Mandalay Bank Protection (Demonstration) (Coastal Engineering and Environmental Consultants, Inc. 2001)

III. Strategy Statement

Project goals will be achieved through the following strategies/project features:

- shoreline protection using sheet pile and a revetment mat system to stop erosion at blowout sites; and
- vegetation plantings with pressure-treated timber fencing and A-Jacks® to stabilize shoreline at off-bank sites.

IV. Strategy-Goal Relationship

The effectiveness of four shoreline protection techniques will be tested while attempting to stop shoreline erosion in specified areas along the southern shore of the GIWW. Two shoreline treatments have been identified (off-bank and blowout) and each treatment will receive three replicates of two protection techniques. The four techniques will serve to reduce wake energies and stop wake-induced erosion, while allowing for statistical comparisons between techniques within each treatment.

By reducing wake energies, erosional forces would be decreased, promoting sedimentation and SAV growth within shallow, open-water areas behind the blowout treatments. As these areas become shallower, mean cover of emergent vegetation in adjacent areas would be increased. As for off-bank treatments, the reduction in wake energies and a subsequent halt in shoreline erosion would allow for an increase in mean cover of planted *Zizaniopsis miliacea* (giant cutgrass).

V. Project Feature Evaluation

Coastal Engineering and Environmental Consultants, Inc. (CEEC) was contracted by the Louisiana Department of Natural Resources (LDNR) to produce a preliminary study and design report for this project. The shoreline protection techniques described in the previous section were recommended by CEEC based on sound engineering designs. For blowout treatments, concrete revetment mats or a straight-walled fiberglass sheet pile system will be used to close the blowout gap. A mud-filled double sinusoidal vinyl sheet pile system will also be considered, as an alternative to the fiberglass sheet pile, following the submission of contractor's bids. The off-bank treatments will include plantings of *Z. miliacea* protected off-shore by either 24" A-Jacks® (single row) or pressure-treated timber fencing in a zig-zag pattern.

Each shoreline protection technique will serve to reduce wake energies and allow for sedimentation at and behind the structure. If the alternative double sinusoidal vinyl sheet pile system (DSVSPS) is selected, the feature would be constructed in a zig-zag displacement pattern. This pattern causes normal vertical vortices (produced from wave energy by a straight sheet pile system) to be converted to horizontal vortices, which eventually slow down and drop sediment at the base of the DSVSPS. The concrete revetment mat system provides a solid barrier that will lessen the wake energy reaching the shoreline. While the sheet pile, revetment mat, and fencing will extend above mean high water (MHW), the A-Jacks® will be constructed as a submersed berm which will slow wake energy, not completely stop it. The timber fencing and A-Jacks® provide a semi-solid barrier to reduce wake energies and protect vegetation plantings, but allows for exchange of water and sediments through the structure.

In addition to the proposed *Z. miliacea* plantings, Kenneth Bahlinger, LDNR Landscape Architect Chief, recommended evaluating *Schoenoplectous californicus* (bullwhip) for the off-bank treatments. Both *Z. miliacea* and *S. californicus* have been planted in the past to stabilize shorelines along navigation canals. Preliminary results of recent LDNR/Natural Resources Conservation Service (NRCS)/Soil and Water Conservation Committee (SWCC) vegetation plantings of these two species have been summarized in Table 1 in an effort to discern which species has the greatest likelihood of planting success on the off-bank treatments.

Table 1. Percent survival of bullwhip and giant cutgrass plantings at eight LDNR/NRCS/SWCC vegetation planting projects.

Project	Date	Salinity (PPT)	Depth	Soil	Number Planted		% Survival (3 mo.)		% Survival (12+ mo.)	
					Bullwhip	Cutgrass	Bullwhip	Cutgrass	Bullwhip	Cutgrass
Bayou Piquante	1996	0	10"	Min	180	--	100	--	0	--
H - H	1996	0	6"	Min	200	300	20	90	20	90
Lake Hatch GIWW	1997	<4	24"	Min	500	--	55	--	10	--
Bayou Chauvin Pipe Canal	1998	2-8	14"	Org	350	--	38	--	0	--
Falgout Canal	1998	2-8	13"	Min	--	2235	--	94	--	21
Humble Canal	1998	<1	24"	Org	2000	--	91	--	71	--
Company Canal	2000	2	6"	Min	--	1800	--	37	--	--
Shell Canal	2000	NA	12"	Org	--	200	--	40	–	--

Success of *Z. miliacea* plantings may depend on several factors including: 1) absence of salinity spikes, 2) presence of mineral soils, 3) absence of wave stress, 4) absence of herbivory pressure, and 5) water depth (Kenneth Bahlinger, personal communication). *Zizaniopsis miliacea* was ultimately selected due to its prevalence throughout the project area.

Many shoreline protection projects along navigation channels are currently in place in coastal Louisiana. However, these projects employ rock breakwater designs to protect shorelines. Projects such as CS-22, CS-24, CS-30, ME-13, and TV-11 identified boat wake-induced erosion as the major problem affecting marsh in the respective project areas. Each project feature involved using rock breakwaters to reduce marsh erosion, but post-construction monitoring data are not available to determine the level of success of these restoration efforts. The Lake Salvador Shoreline Protection Demonstration project (BA-15) tested the effectiveness of vinyl sheet pile bulkheads in protecting lake rim shoreline, but sheet pile was constructed in a continuous row configuration and not the double sinusoidal pattern proposed for TE-41. Results for the sheet pile treatment at Lake Salvador indicated that pre-construction shoreline erosion rates were -1.42 m/yr compared to the -5.98 m/yr and -1.39 m/yr erosion rates measured at 6 months post-construction and 2 years post-construction, respectively (Lee et al. 2000).

The Freshwater Bayou Wetlands project (ME-04) also used rock breakwaters as a means to reduce boat wake-induced erosion along a navigation channel in Vermillion Parish. Erosion rates along the banks of Freshwater Bayou between 1968 and 1992 averaged 12.5 ft/yr (Brown and Root 1992), and the width of this navigation channel had increased threefold by 1990. Deterioration of the channel banks resulted in losses of 1,124 acres (455 ha) of adjacent marsh (Good et al. 1995). However, with project features in place, monitoring data from 1995 to 1998 showed a significant difference in shoreline change between the project area (+2.34 ft/yr) and the reference area (-6.54 ft/yr). Although post-construction data indicates that rock protection was effective at ME-04, demonstration projects are needed to develop alternative techniques which are suitable for construction on highly erodible organic soils.

There is a degree of risk associated with the physical features of the project. The revetment mat system, sheet pile, A-Jacks®, and fencing will be subjected to continuous wave action and tidal scour. These forces could potentially cause structural failure or contribute to subsidence of the structures. Eustis Engineering (retained by CEEC) performed a detailed geotechnical investigation of the project area and determined that soils are strong enough to support proposed shoreline protection features. However, CEEC has recommended that monitoring of engineering parameters (scouring, settlement, etc.) should be carried out in addition to the monitoring of biological parameters.

VI. Assessment of Goal Validity/Attainability

Biotic Goals

Demonstration projects can test the effectiveness of multiple restoration techniques. It is difficult to quantitatively evaluate the effectiveness of the project features due to the fact that data from projects utilizing these types of features are unavailable. Results from this experimental shoreline protection approach will be used to plan future projects of similar scope.

With the proposed structures in place, wake energies will be dissipated (although the amount of dissipation is unclear) thereby reducing or stopping the shoreline erosion. In a reduced energy environment, sediments will likely settle out, promoting SAV growth and increasing mean cover of emergent marsh vegetation as well. Specified goals of this project are valid given the erosional threats to marshes within the project area. Success in achieving these biotic goals will be determined by the experimental shoreline protection techniques.

Abiotic Goal

The degree in which the abiotic goal is achieved, directly depends on the projects' experimental design. Each technique will be replicated three times and statistical comparisons will be made between each technique within each treatment and to control sites. The original experimental design was modified based on suggestions from the Draft Ecological Review and subsequent discussions following the 30% Design Review meeting. The finalized experimental design includes sufficient replication of all treatments (and techniques within each treatment) and controls. These modifications will allow for valuable statistical comparisons to be made between the four shoreline protection techniques and controls.

One example of testing new restoration methods using poor experimental design was the Lake Salvador Shoreline Protection Demonstration Phase I (BA-15). While the need to test the effectiveness of new shoreline protection methods was realized, this demonstration project did not allow for statistical comparisons between the different methods. It yielded only wave energy reduction data, but had the potential to produce a plethora of valuable information on shoreline erosion rates. Problems associated with this project included: 1) treatments placed too far offshore to be effective, 2) treatment replicates were grouped, instead of placed in a random order along the shoreline, and 3) treatments were placed in such close proximity that treatment interactions were noted. It is extremely important to recognize the weaknesses of past demonstration projects in order to effectively design future projects to achieve desired goals.

VII. Summary of Findings

It is recommended that the Mandalay Bank Protection (Demonstration) project be constructed with treatments and controls placed according to the modified experimental design.

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