5.0. INITIAL SCREENING OF ALTERNATIVES

5.1. Introduction

In this section, the process by which the team defined and analyzed the initial set of alternatives is described. The analytical process used by the study team involved first identifying and describing broad "strategic options" for shoreline restoration. These strategic options are then qualitatively evaluated according to resource benefit criteria. The result of this process is the selection of a smaller set of "management alternatives". These management alternatives are quantitatively analyzed in later steps utilizing hydrologic modeling, wave modeling, and detailed environmental and economic data. The information presented here is explained in more detail in the Step I report – "Formulation of Strategic Options".

5.2. Methodology

The alternative analysis process began with five strategic options identified in the LA DNR Request for Proposals. These strategic options were broadly defined engineering concepts of potential island configurations or, in the case of "strategic retreat", management concepts. It was necessary to further define the options to adequately analyze the associated effects. After defining the options in greater detail, the team qualitatively analyzed the options using an evaluation methodology based on the resource benefits associated with each strategic option. These resource benefits were categorized into social, environmental, economic, and engineering groups. The evaluation criteria were based on the previously identified problems, needs, and opportunities.

Because of differing features and conditions, the evaluation of the alternatives was done on a sub-area scale. In addition to recognizing physical differences, this technique allowed for localized analysis of the strategic options. The options were evaluated independently in each sub-area (pp. 75-76). This process produced an evaluation of alternatives according to benefits provided for each sub-area.

The evaluation methodology relied on *qualitative* assessments made by professionals with personal knowledge of the study area. This evaluation was considered the first level of analysis, which would recommend one or more strategic options that need to be quantitatively analyzed in greater detail in later steps of this study. The following evaluation system was used to assess the effect of each strategic option on the various resource categories:

(1)	HP	High Positive
(2)	MP	Medium Positive
(3)	NE	No Effect
(4)	MN	Medium Negative
(5)	HN	High Negative

This system is not numerically based and is not meant to provide any quantification of benefits. Two alternatives could receive identical evaluations. The evaluations were not mutually exclusive.

To evaluate the alternatives, the team was divided into four groups according to their areas of expertise (engineering, environmental, social, and economic). Each group developed its own evaluation criteria based on the problems, needs, and opportunities described in Section 4, and developed a matrix for each of the sub-areas. This method allowed evaluation of each strategic option by each evaluation criteria in each sub-area.

After developing the criteria, each group completed a matrix for each sub-area according to the evaluation criteria for each strategic option. The four groups then met to evaluate the options collectively. Each group presented its analysis and rational to the entire study team. The team used an interactive group dynamic which relied on personal knowledge of the study area and resource assessments completed in previous steps. Once the matrices were presented, each group recommended two options for each sub-area.

5.3. Initial Array of Alternatives

The initial array of five strategic options, as defined in the LDNR Request for Proposals, were: 1) No-action, 2) Strategic Retreat, 3) Fall Back of New Barriers, 4) Pre-Hurricane Andrew Configuration, and 5) Historic Barrier Configuration. As mentioned, the description in the RFP was vague. To support the initial analysis of alternatives, it was necessary for the team to further define the strategic options. The following are the descriptions of strategic options used by the study team in this analysis.

5.3.1. No-action

The no action option is a projection of future conditions if no restoration effort is initiated. In this case, it has been assumed that the authorized CWPPRA projects (through 1995) will be implemented, and the long-term benefits of these projects will be credited. This option also considers the benefits of the Davis Pond Freshwater Diversion Project. Beyond these projects, it is assumed that no further coastal restoration efforts will transpire.

5.3.2. Strategic Retreat

The concept of strategic retreat is a management concept in which the dynamic nature of the shoreline and associated wetlands is recognized, and requires humans to retreat in response to the natural processes without interfering with those processes. The concept of strategic retreat accepts the fact that the shoreline and associated wetlands are dynamic and humans are expected to respond accordingly. Under this option, both natural habitat and human infrastructure are allowed to migrate landward leaving space for nature to inundate and create new habitat.

5.3.3. Fall Back of New Barriers

This option involves construction of a fall-back line of new barriers landward of the present coastline (Figure 5-1). These barriers are designed to simulate the form and function of healthy barrier islands, while providing protection closer to the inland marsh. The existing barrier islands in this option are considered to be sacrificial and are allowed to deteriorate, leaving the basin-wide fall-back barrier to function in the long-term. For this level of analysis, the fall-back barriers have been assumed to be constructed using sand and other sediments.

The fall-back position would take advantage of existing topographic features (e.g., mainland marshes, former barrier trends, existing ridges, distributary levees, etc.). The fall-back option would begin at Caillou Bay and continue eastward along the northern edge of Lake Pelto. The barriers would follow the southern boundaries of Lake Barre and Lake Raccourci and stop at the western side of the Bayou Lafourche Headland. No feasible opportunities exist for the fall-back option in the vicinity of the Bayou Lafourche Headland and Caminada-Moreau Headland. The Bayou Lafourche Headland is an attached shoreline and hence, does not facilitate construction of a fall-back line. Grand Isle is expected to exist for the next 100 years and hence, a fall-back barrier is not necessary (Refer to Step G of the Study for details). At Barataria Pass, the fall-back option would extend northward and surround Barataria Bay. At the southern portion of Bay Batiste, the fall-back barriers would follow a fault line north of Lake Grand Ecaille to Empire. All major navigation passes are left open.

5.3.4. Pre-Hurricane Andrew Configuration

Preserving the pre-Hurricane Andrew configuration is an option that restores the barrier shoreline to reflect the 1988 inlet configuration, and would be restored and maintained to an average width of 1,230 feet, which was approximately the average island width throughout the Study Area in 1988 (McBride *et al*. 1992) (Figure 5-2). As defined, all breaches developed after 1988 will be sealed, while the inlets remaining open will be returned to their 1988 width. A dune height of 6.6 feet is projected to prevent overwash from fronts and tropical storms. Raising dune heights could reduce erosion rates by acting as a sand source during hurricanes and offering protection to backdune vegetation that stabilizes the island. Dunes also supply material to counter overwash surges for low frequency events, such as a hurricane landfall (Leatherman 1981). The increased width of the island will also provide more terrestrial habitat and will serve as a platform on which overwashed material could accumulate.

Figure 5-1. Barrier Island Plan - Strategic Option 3, Fall-Back Line of New Barriers

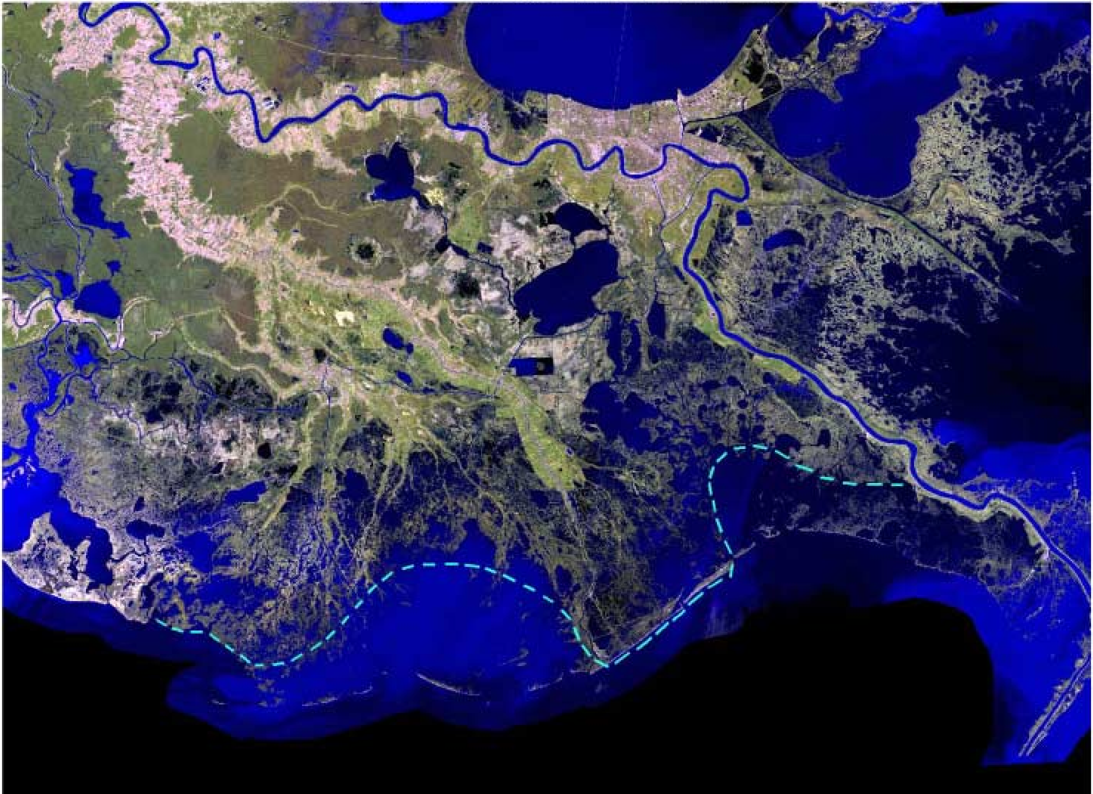
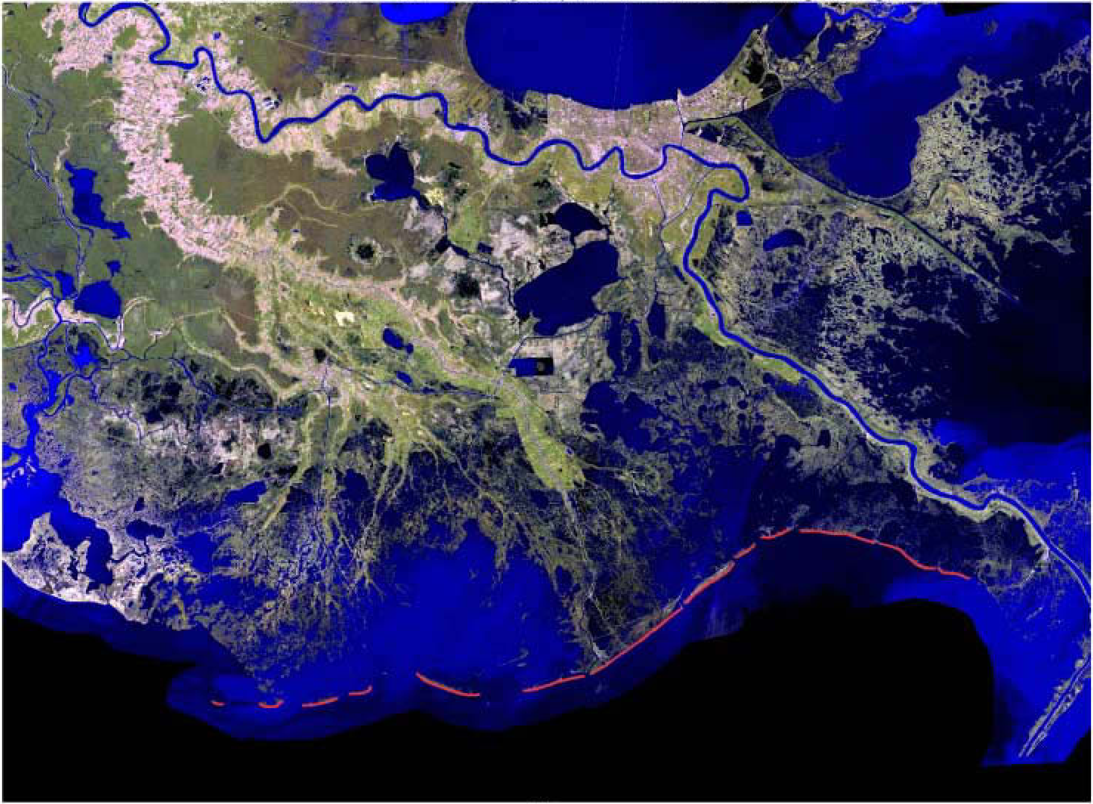


Figure 5-2. Barrier Island Plan - Strategic Option 4, Preserve Existing Configuration



5.3.5. Historic Barrier Configuration

This option involves restoration of the barrier islands to an historic barrier configuration (Figure 5-3) which is equivalent to the functional configuration (not position) of the inlets of 1880, as depicted in *the USGS Shoreline Change Atlas* (McBride *et al*. 1992). The historic configuration would be built on present barrier island features. All breaches and inlets would be sealed except for major tidal inlets that were in existence in the late 1800s (i.e., Wine Island Pass, Cat Island Pass, Little Pass Timbalier, Belle Pass, Caminada Pass, Barataria Pass, Quatre Bayou Pass, Pas la Mer, Chaland Pass, Grand Bayou Pass, Fontanelle Pass, and Scofield Bayou Pass). Overall, the coastal wetlands would be fronted by a continuous barrier shoreline except for major tidal entrances. Increases to the island width would be landward from the existing shoreline position.

The historic island configuration will have a width of 1,970 feet and a dune height of 8.9 feet. The 1,970 feet width represents the approximate average width of the barrier shoreline in 1978 (McBride *et al.* 1992). This representative width achieves the goal of providing a larger island than the pre-Hurricane Andrew option, but is limited to a design width of 1,970 feet to provide a practical configuration. An 8.9 feet dune height represents the larger dune heights of some natural dunes located on the barrier islands in Louisiana and will prevent overwash of fronts, tropical storms, and Category 1 hurricanes (Boyd and Penland 1981).

Figure 5-3. Barrier Island Plan - Strategic Option 5, Preserve Historic Configuration

5.4. Qualitative Analysis of Alternatives

In this section, the qualitative analysis of the strategic options is described. For the evaluation, the resources were defined into four major categories: environmental, social, economic, and engineering. Each resource category contains individual category criteria. The specific criteria used were based on the problems, needs, and opportunities identified previously. Those specific criteria are as follows:

- **Environmental** - The evaluation criteria selected under this category include wetland protection, restoration and creation; land loss prevention; protection and enhancement of flora and fauna, especially threatened and endangered species; and protection, restoration, and creation of barrier shoreline habitat.

- **Social** - The evaluation criteria under this category include population characteristics and demographic patterns, health and safety, jobs and employment, and recreational opportunities.

- **Economic** - The evaluation criteria under this category include residential, commercial, and industrial structures; port facilities; farmland and agricultural resources; public resources; parks and recreational facilities; and archaeological sites.

- **Engineering** - The evaluation criteria under this category include longevity of restoration efforts; facility relocation, real estate and right-of-way acquisition; and compatibility of restoration efforts with hurricane protection and freshwater diversions in the basin.

The Phase 1 study area barrier shoreline was divided into four sub-areas, shown in Figure 5-4, following the scheme in the U.S.G.S. *Atlas of Shoreline Changes in Louisiana 1853-1989* (McBride *et al.*, 1992). This division enables the qualitative evaluation to be more effective and site specific. The strategic options were evaluated by forming a series of matrices for each resources category under each sub-area. The four sub-areas are:

- Isles Dernieres Chain
- Timbalier Chain
- Caminada-Moreau Headland
- Plaquemines Shoreline

The study team was divided into environmental, economic, social, and engineering workgroups. Each group evaluated the strategic options according to that group's resource criteria. The result was a matrix for each resource workgroup, which evaluated the strategic options by resource criteria in each sub-area. Table 5-1 is the environmental resource group's matrix. Similar matrices were created for economic, social, and engineering criteria.

Following the completion of the individual resource group evaluations, the team met to discuss each group's preferred options and to ultimately recommend those options for more detailed analysis. In Table 5-2, the two options with the greatest benefit are presented for each subgroup in each sub area. Each resource group presented its evaluation and explained the rationale for their conclusions. Other team members questioned the groups and suggested alternative evaluations. This process improved the analysis by forcing team members to substantiate their evaluations in response to criticism.

After each group presented its conclusions, the team combined their evaluations into two study area recommendations. This combination was based on the conclusions from each group equally. The historic configuration and the pre-Hurricane Andrew configuration options were those most preferred by the economic, social, and environmental resource groups.

In the Isles Dernieres, Timbalier, and Caminada-Moreau Headland/Grand Isle sub-areas, the engineering group considered the fall-back option more appropriate than the pre-Hurricane Andrew configuration. The differences in the engineering evaluation between the fall-back option and the pre-Hurricane Andrew configuration were small. Because the other groups agreed that the pre-Hurricane Andrew configuration should be a recommended option and because there were only marginal differences in the engineering evaluation between the fall-back option and the pre-Hurricane Andrew option, the second overall team option was the pre-Hurricane Andrew option.

Figure 5-4. Barrier Island Plan - Sub-Area Definition

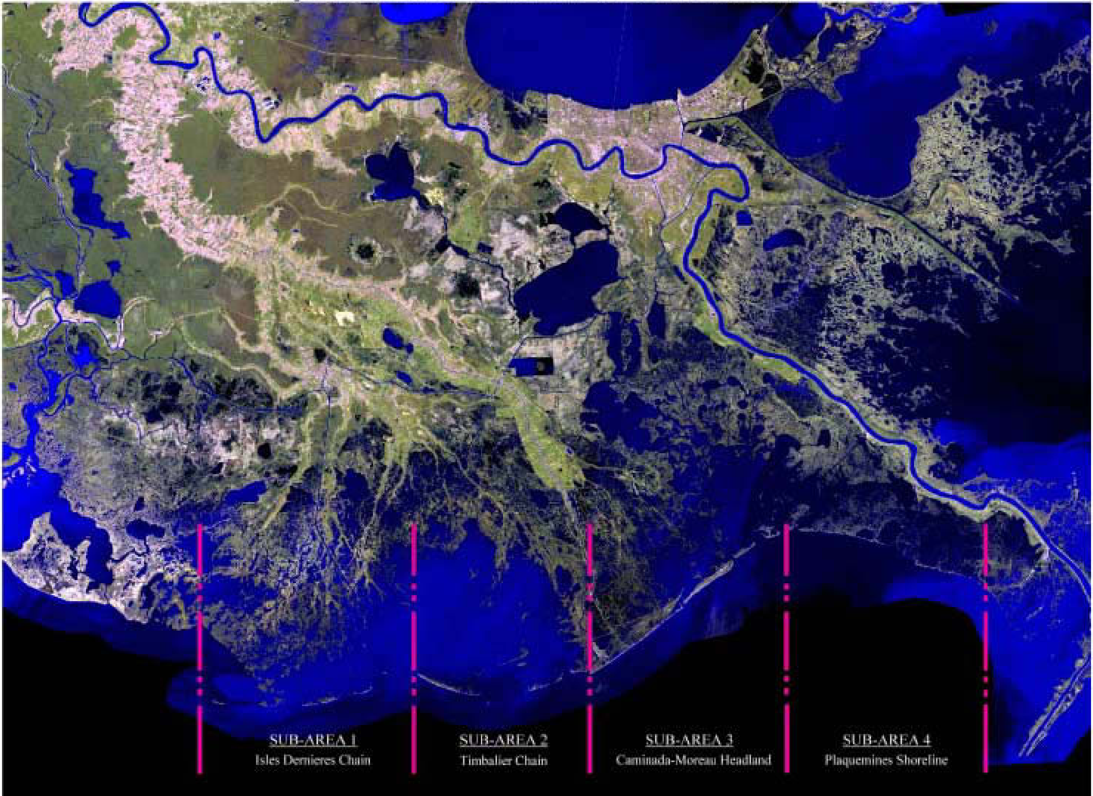


Table 5-1. Environmental Resources
Preliminary Evaluation of the Strategic Options

Sub-Area	Evaluation Criteria	Strategic Options				
		No Action	Strategic Retreat	Fall-Back Option	Pre-Hurricane Andrew Configuration	Historic Configuration
Isle Dernieres Island Chain	Wetlands Protection, Restoration, and Creation	HN	HN	MP	MP	HP
	Land Loss Prevention	HN	HN	MP	MP	HP
	Impact on Flora (Terrestrial and Aquatic)	HN	HN	MP	MP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	HN	HN	HN	MP	HP
	Impact on Threatened and Endangered Species	HN	HN	MN	MP	HP
	Barrier Island Habitat Protection, Restoration, and Creation	HN	HN	NE	MP	HP
Timbalier Island Chain	Wetlands protection, restoration, and creation	HN	HN	MP	MP	HP
	Land loss prevention	HN	HN	MP	MP	HP
	Impact on Flora (Terrestrial and aquatic)	HN	HN	MP	MP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	HN	HN	HN	MP	HP
	Impact on Threatened and endangered species	HN	HN	MN	MP	HP
	Barrier Island habitat protection, restoration, and creation	HN	HN	NE	MP	HP
Caminada-Moreau Headland	Wetlands protection, restoration, and creation	HN	HN	MP	MP	HP
	Land loss prevention	HN	HN	MP	MP	HP
	Impact on Flora (Terrestrial and aquatic)	HN	HN	MP	MP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	HN	HN	MP	MP	HP
	Impact on Threatened and endangered species	HN	HN	MP	MP	HP
	Barrier Island habitat protection, restoration, and creation	HN	HN	MP	MP	HP
Plaquemines Shoreline	Wetlands protection, restoration, and creation	HN	HN	MN	MP	HP
	Land loss prevention	HN	HN	MN	MP	HP
	Impact on Flora (Terrestrial and aquatic)	HN	HN	MN	MP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	HN	HN	MN	MP	HP
	Impact on Threatened and endangered species	HN	HN	MN	MP	HP
	Barrier Island habitat protection, restoration, and creation	HN	HN	MN	MP	HP

Table 5-2. Summary of Evaluation Results

Resources	Sub-Area							
	Isle Dernieres Sub-area		Timbalier Sub-area		Caminada-Moreau Headland/Grand Isle Sub-area		Plaquemines Sub-area	
	Rank I	Rank II	Rank I	Rank II	Rank I	Rank II	Rank I	Rank II
Environmental	HC	PA	HC	PA	HC	PA	HC	PA
Social	HC	PA	HC	PA	HC	PA	HC	PA
Economic	HC	PA	HC	PA	HC	PA	HC	PA
Engineering	HC	FB	HC	FB	HC	FB	HC	PA

FB - Fall-Back Option
PA - Pre-Hurricane Andrew Configuration
HC - Historic Configuration

5.5. Selection of Alternatives for Further Study

In combining the sub-area recommendations into the overall Study Area recommendations, the team considered the systemic effects of implementing the options. During this evaluation, it was recognized that there were nuances in the sub-areas not recognized in these broad options. The team realized that the broad options outlined in the Request for Proposals did not completely meet the individual needs of all the sub-areas and that these needs could be addressed by modifications to the strategic options. In some areas, combinations of options were necessary to maximize the benefits. While in other areas, the marginal benefits of the most favorable option were minimal when compared to the second option. The team utilized the completed evaluation and the expertise developed from the evaluation to modify the selected options. The following are the two management alternatives that resulted from this process and were recommended for further study.

Alternative 1

Alternative 1 begins at the western end of the study area at Whiskey Island (Fig. 5-5). Whiskey Pass is closed thereby creating a continuous barrier shoreline from Coupe Colin to Wine Island Pass. New Cut is also closed, making Whiskey, Trinity, and East Islands one continuous island. Wine Island Pass is left open, but Wine Island is expanded. The islands would be constructed with a dune height of 9.0 feet approximately 50 feet wide. A 1,500-foot vegetated marsh platform would be created along the backside of the islands. The beach would be fronted by either a beach berm or other shoreline stabilization as discussed in Sections 6 and 7. The overall island “footprint” width is approximately 1,970 feet.

Second lines of defense included in Alternative 1 are called “wave absorbers”. Wave absorbers function similar to breakwaters to reduce wave energy that impacts the marsh shoreline in the bays. However, the wave absorbers are not intended to promote accretion and should allow hydrological exchange between the marsh and bays. These interior structures begin at the mouth of Bayou Grand Caillou, paralleling the marsh shoreline to the southeast, ending due north of Whiskey Island’s west end. They begin again north of Wine Island Pass in Lake Pelto at the marsh fringe and follow the southern end of Lake Barre and Lake Raccourci, down to Pierle Bay in the southeast corner of Timbalier Bay.

Raccoon Island was not included in Alternative 1. The team felt that the potential marsh preservation benefits for restoring and connecting Raccoon Island to the rest of the Isles Dernieres chain could also be provided by a set of wave absorbers in Caillou Bay. The island habitat benefits could be provided by the restored Isles Dernieres to the east. Additionally, the engineering group felt that the incremental cost to restore and connect Raccoon Island would be extremely high. Restoration of Raccoon Island was included in Alternative 2.

Cat Island Pass remains open, and Timbalier Island is rebuilt. Little Pass is left open, and East Timbalier Island is rebuilt and connected to the Caminada-Moreau Headland, closing Raccoon Pass. The islands are rebuilt to the same specifications as the Isle Dernieres chain.

The Caminada-Moreau Headland and Grand Isle area are rebuilt to a dune height of 9.0 feet, but the existing shoreline is not widened. The Plaquemines shoreline is rebuilt to the same specifications as the Isle Dernieres and Timbalier sections, but Barataria Pass, Coup Abel, Quatre Bayou Pass, and several smaller passes are left open.

<u>Alternative 2</u>

At the western end of Isle Dernieres, Raccoon Island is rebuilt and reconnected to Whiskey Island by closing Coup Colin (Fig. 5-6). Whiskey Pass is left open, with Trinity and East Island connected due to the closure of New Cut. These islands would be built with a dune height of approximately 6.6-feet with a 50-foot width. A smaller dune height was used to reduce costs, although a preliminary dune height design and cost analysis is discussed in the Step K report (LDNR 1998k). The marsh platform is approximately 800 feet wide along the backside of the islands. The beach would either be fronted by a beach berm or other shoreline stabilization as discussed in Sections 6 and 7. The overall project “footprint” of Alternative 2 has a width of 1,230 feet.

Cat Island Pass is left open and Timbalier Island is rebuilt. Little Pass is left open, and East Timbalier Island is rebuilt and connected to the Caminada-Moreau Headland by closing Raccoon Pass. These islands are rebuilt to the same specifications as the Isle Dernieres chain.

The Caminada-Moreau Headland and Grand Isle are also rebuilt to the same specifications as the Isle Dernieres chain. At the Plaquemines shoreline, Barataria Pass, Coup Abel, Quatre Bayou Pass, and several smaller passes are left open. This area is also rebuilt to the same specifications as the other island chains.

Figure 5-5. Barrier Island Plan - Management Alternative 1

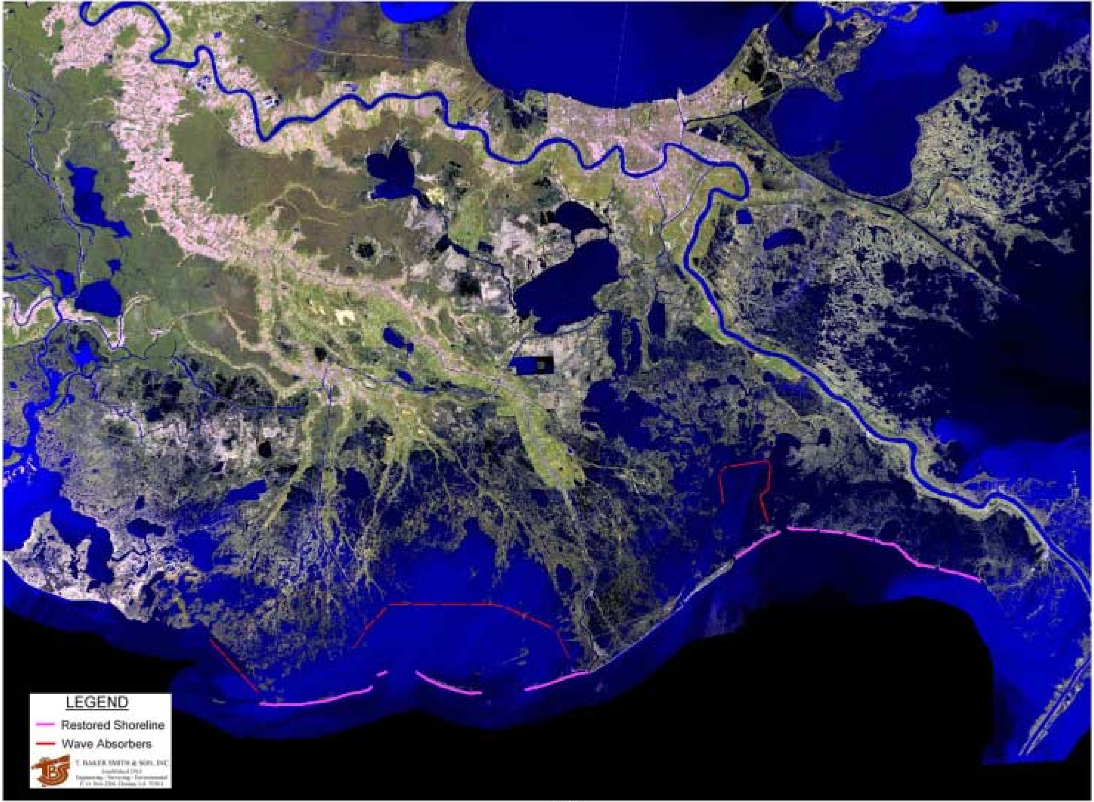


Figure 5-6. Barrier Island Plan - Management Alternative 2

6.0. ALTERNATIVES ANALYSIS

After the initial screening of options and development of Alternatives 1 and 2 was completed, the study team compared the alternatives to the future without-project conditions. Changes to the physical and hydrological conditions associated with the alternatives were made and used to analyze impacts to economic and environmental resources. A detailed discussion of the analysis of alternatives is found in Step J - Assessment of Management Alternatives.

6.1. Methodology

The method used to develop the wetland habitat maps for Alternatives 1 and 2 was a modification of the method used to develop the no-action land/water maps. Areas experiencing shoreline erosion from wave action were separated from those experiencing interior loss. Land loss rates for the new "shoreline polygons" were provided by the CWPPRA Steering Committee and projected into the future to allow the study team to evaluate the wave dampening impacts of the alternatives.

The modeled reduction in wave energy due to the alternatives was determined using the change in mean wave height, where the mean waves were greater than 0.3 feet. This reduction in wave energy was used to adjust the amount of land loss along the marsh shorelines.

The alternatives decreased (compared to no-action) the impact of wave energy in the marsh shoreline polygons. This decreased wave climate had the effect of preserving marsh compared to the no-action alternative. This preserved marsh was "added back" to the no-action land/water maps. The same pseudo-color scale used in the original LANDSAT image was then applied to produce "future with project" images. Salinity, tide, and storm surge models were run on the new land-water configurations and evaluated to determine benefits to the economic and environmental resources. Benefits were calculated at 30- and 100-years. The 100-year timeframe was used to ensure a measurable magnitude of impacts and analyze trends.

6.2. Alternative 1

A description of Alternative 1 is found in Section 5. Alternative 1 is the largest proposed barrier island option providing habitat and a protective gulf shoreline extending 78.3 miles.

6.2.1. Physical Conditions

By constructing Alternative 1, 15,680 acres (24.5 mi^2) (Table 6-1) of wetland and island habitat on the islands would be created. Alternative 1 also includes construction of a set of wave absorbers placed along the margin of selected regions of saline marsh in Caillou Bay, Terrebonne Bay, Timbalier Bay, and Barataria Bay. Alternative 1 would be maintained on a 5-year cycle.

Table 6-1. Acres of Emergent habitats associated with Construction of Alternative 1

Island habitat	
Beach	2,339
Vegetated Dune	966
Saline Marsh	12,325
Total Land	**15,680**

In addition to the above effect, the construction of Alternative 1 would prevent the loss of 8,924 acres (13.9 mi^2) of bay shoreline marsh in 30-years and 20,098 acres (31.4 mi^2) in 100-years compared to the future without project. The majority of the land loss prevented is saline marsh and shore/flat habitat in Terrebonne Bay. The habitats benefited by Alternative 1 are discussed in Section 6.2.5.

6.2.2. Tides

The tidal simulations indicate that the Alternative 1 will have an overall effect of slightly decreasing tidal amplitude in the study area. Table 6-2 indicates that for 11 sites that are flooded currently, 8 sites will experience a decrease, while 3 sites will remain unchanged.

As an example, Figure 6-1 shows the effect of Alternative 1 on tidal amplitudes for the present configuration for St. Mary’s Point. For present conditions, the decrease in amplitude is about 0.4 to 0.8 inches at St. Mary’s Point. The tidal simulations for the 30- and 100-year configuration are shown in Figures 6-2 and 6-3. Each figure shows a decrease in tidal amplitude for Alternative 1. At St. Mary's Point, Alternative 1 has a tidal amplitude of 5.1 inches compared to 6.1 inches for 30-year no-action. In 100-years, the tidal amplitude decreases sharply under Alternative 1 to 2.3 inches compared to 4.7 inches under no-action. This projected decrease is due to the fact that while the inlets in the barrier islands are assumed to be stable, the bay area in the study area has increased in 100 years so a fixed tide is spreading over a larger area.

Table 6-2. Alternative 1 Changes in water level for future projections. X = no change or not flooded. V = flooded and/or change in water level, NC = no change from no action, D = decrease from no action.

Station Name	No-action		Alternative 1	
	30 yr	100 yr	30 yr	100 yr
Venice	V	V	NC	NC
Port Sulphur	X	V	X	X
St. Mary's Point	V	V	D	D
Lafitte	X	X	X	X
Bayou Perot (S)	V	V	NC	NC
Lake Salvador	V	V	D	D
Leeville	V	V	D	NC
Golden Meadow	X	X	X	X
Bully Camp	X	V	X	D
Caillou Island	V	V	D	D
Lac des Allemands	V	V	D	D
Madison Canal	X	X	X	X
Cocodrie	X	V	X	X
Falgout Canal[1]	V	V	NC	D
HNC at GIWW	V	V	NC	D
Minors Canal	V	V	NC	D
Sister Lake	V	V	NC	NC
Jug Lake	V	V	NC	NC
Lost Lake	X	X	X	X
Bayou Penchant (W)	X	X	X	X
Amelia	X	X	X	X

Figure 6-1. Elevation vs. Time (Present)

At St. Marys Point

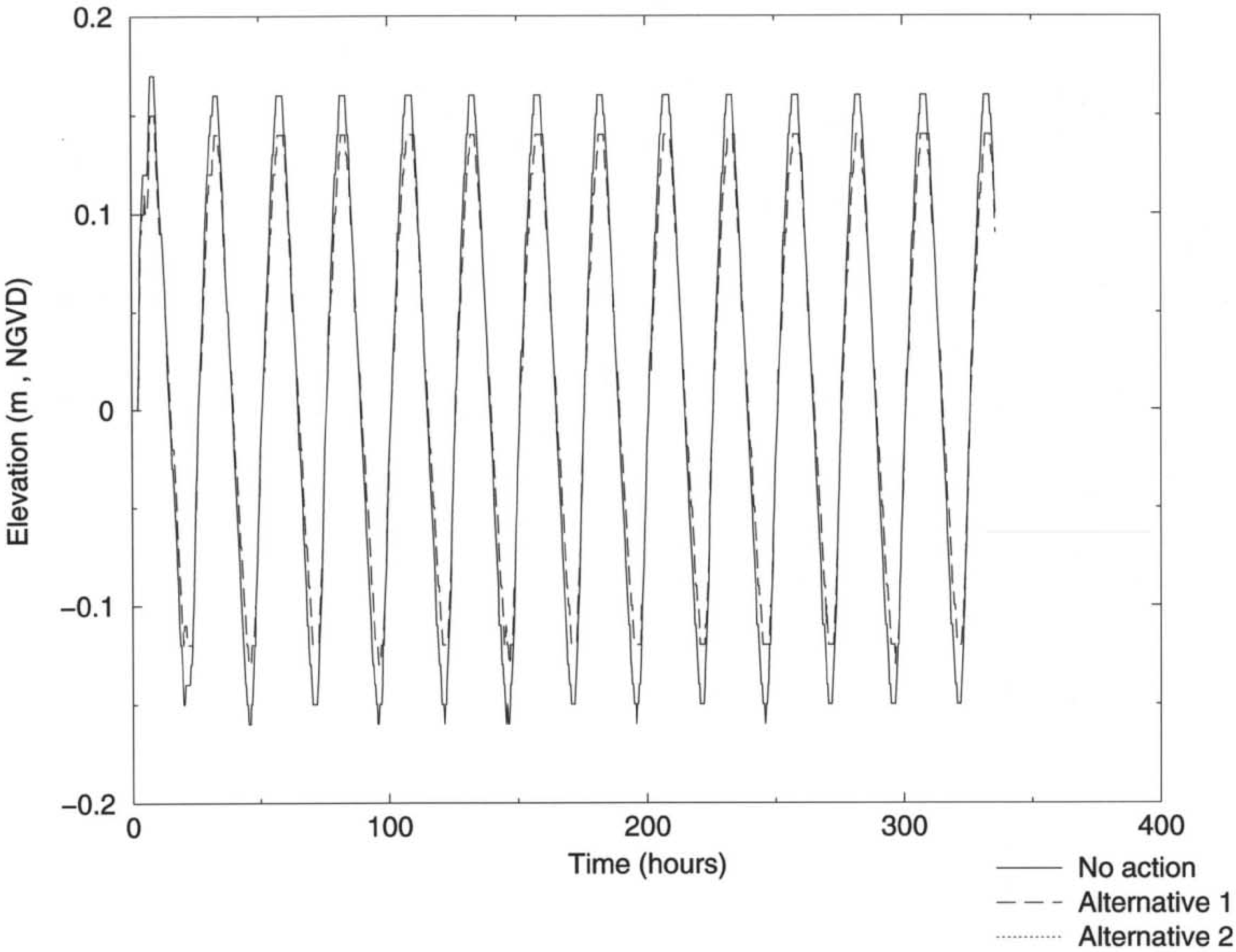


Figure 6-2. Elevation vs. Time (30-Year)

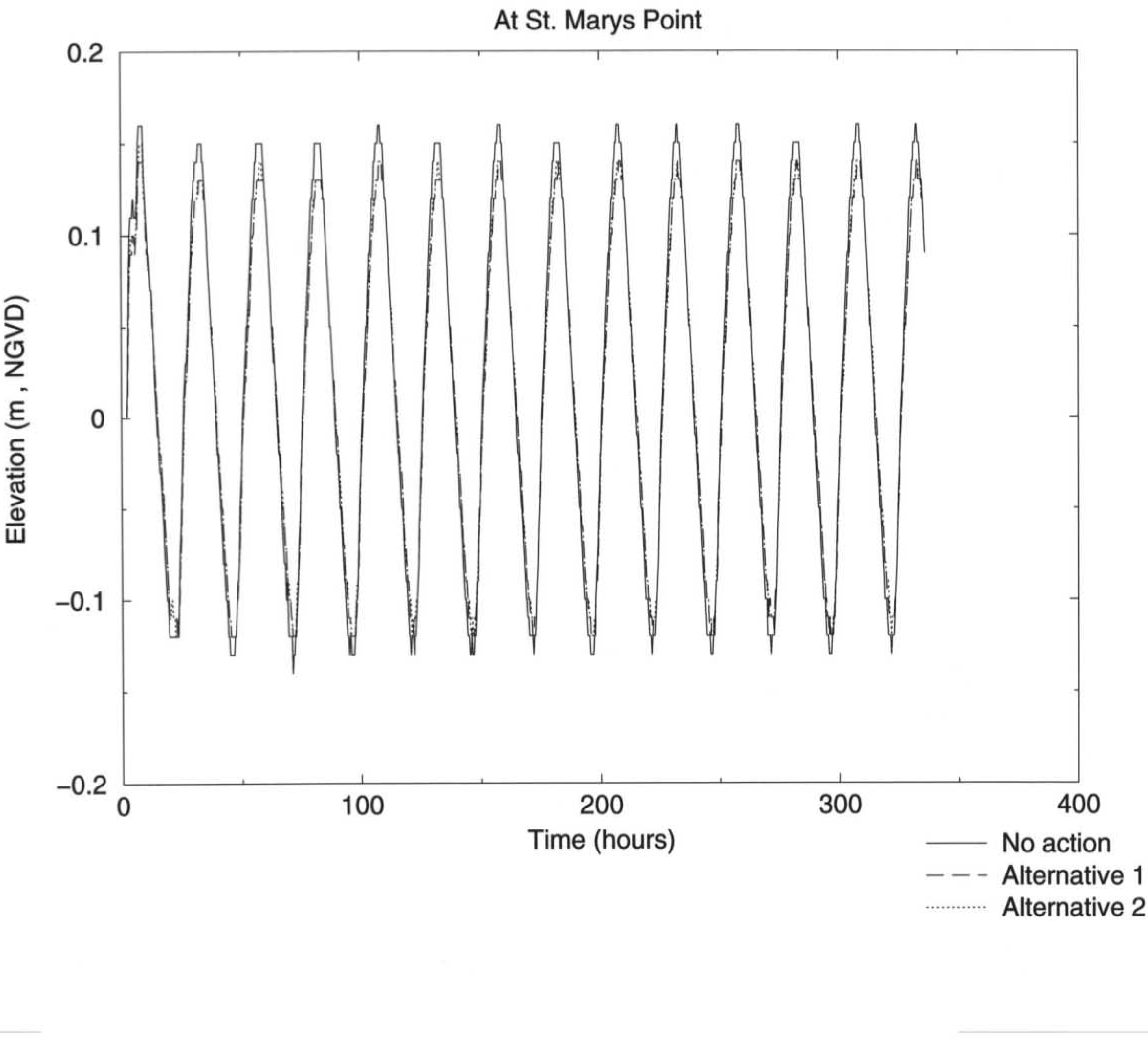
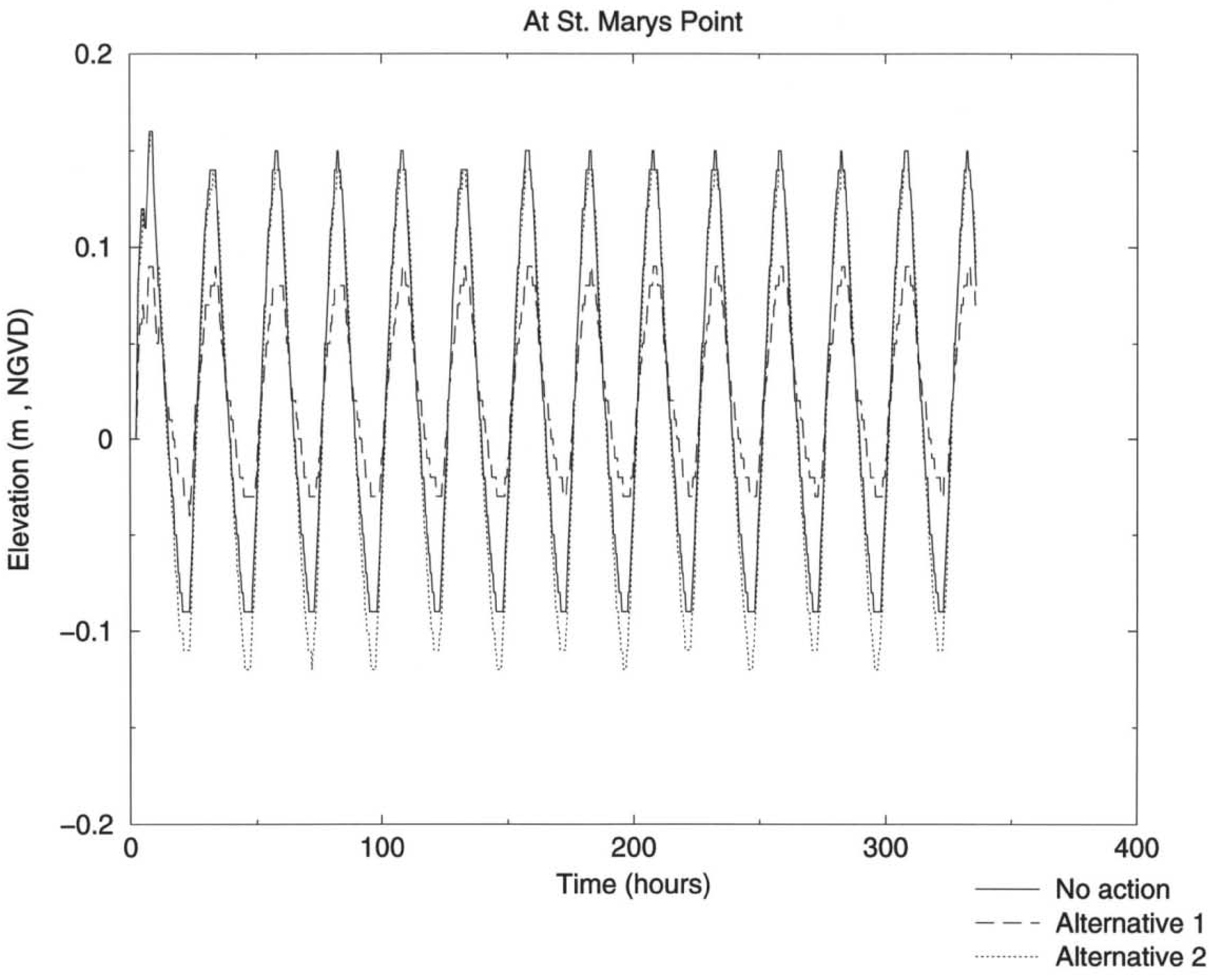


Figure 6-3. Elevation vs. Time (100-Year)



6.2.3. Salinity

The results of the salinity simulations indicate the effects of Alternative 1 are generally restricted to areas adjacent to the islands. For year 30, the salinity differences for Alternative 1 compared to no-action are greatest north of Timbalier Island. Salinity decreases in Terrebonne Bay immediately north of the islands by over 3 ppt. Decreases in salinity also are indicated in Barataria Bay north of Grand Terre and in Caillou Bay north of Isles Dernieres. The salinity decreases are 1 to 2 ppt. Salinity seaward of the barriers show a slight increase of about 1 ppt due to the barrier islands limiting exchange along the gulfside of the island. For year 100, Alternative 1 has a much larger effect north of the Timbalier Islands. A large area of the bay shows a salinity decrease greater than 3 ppt. A slight increase in salinity is indicated near Shell Island. This is due to the reduction of tidal exchange in Alternative 1 in this area resulting from closure of breaches, as opposed to the erosion associated with no-action.

Alternative 1, when combined with the Davis Pond diversion has a large impact in changing salinity and circulation patterns in Barataria Bay. With these two projects combined, most of the southern part of Barataria Bay is projected to experience a decrease in salinity of over 3 ppt. A more detailed discussion on the impacts of Alternative 1 on salinity is found in the Step J report (LDNR 1999j).

6.2.4. Hurricane Surge

The results of the hurricane simulations indicate that flooding is generally reduced by implementing Alternative 1. The maximum flood elevations for the various time series locations are summarized in Tables 6-3 and 6-4. These tables depict the maximum flood elevation averaged between the present, 30- and 100-year periods due to the surge elevation for Alternative 1 and no-action. This information is used to analyze the economic benefits of decreased flooding.

Table 6-3. Average* maximum flood elevation for the Track 1 hurricane (feet) – Alt. 1

Location	No-action	Alternative 1
Bully Camp	5.90	3.60
Caillou Island	4.60	1.65
Cocodrie	3.80	3.60
Golden Meadow	5.90	5.40
Lafitte	9.00	5.75
Lake Salvador	3.95	1.80
Leeville	6.90	4.75
Port Sulphur	10.80	7.20
St. Mary's Point	7.90	3.30
South Bayou Perot	6.55	4.25
Venice	4.40	3.95

* Average of present, 30- and 100-year

Table 6-4. Average* maximum flood elevation for the Track 2 hurricane (feet) – Alt. 1

Location	No-action	Alternative 1
Amelia	8.70	8.35
Bully Camp	10.65	8.35
Bayou Penchant	8.00	8.00
Cocodrie	9.50	6.90
Falgout Canal	9.85	8.20
Golden Meadow	5.40	4.60
Houma Navigation Canal	11.15	10.15
Jug Lake	11.00	10.15
Lafitte	5.90	4.10
Lac des Allemands	7.55	6.25
Lake Salvador	6.05	4.60
Leeville	5.10	3.45
Lost Lake	9.85	9.20
Madison Canal	8.85	6.55
Minor's Canal	11.30	10.15
Port Sulphur	5.10	4.10
Sister Lake	11.30	10.15
South Bayou Perot	5.10	3.60

* Average of present, 30- and 100-year

6.2.5. Waves

Under fair-weather wave conditions, waves approaching from the south are significantly reduced in height in the immediate lee of the restored barriers and for considerable distances landward towards the marsh shoreline (LDNR 1999j). Along the western flank of the Isles Dernieres (Area 1), an approximate reduction in incident wave height of between 50 and 70%

occurs due to wave energy dissipation over the shoal system seaward of Caillou Bay. Overall, the average wave height along the Caillou Bay shoreline ranges from 0-0.1 feet under Alternative 1 compared to 0.4 feet and 0.6 feet under no-action in 30- and 100-years respectively. In Lake Pelto, the limited fetch and barrier restoration combined results in considerably lower wave heights. Under Alternative 1, the average wave height along the Lake Pelto shoreline is 0.2 feet compared to 0.6 and 1.3 feet for the 30-and 100-year no-action predictions.

A substantial amount of wave energy transmission through Cat Island Pass is evident and continues across the bay to the flanking marsh shoreline. In Area 2, the average wave heights along the marsh shoreline are reduced to 0.1-0.3 feet under Alternative 1 compared to 0.3 to 0.5 feet for no-action in 30- and 100-years respectively. Wave regeneration is apparent along the central and northern flanks of Timbalier Bay, whereas to the south and in the lee of the restored barrier islands, wave heights are minimal. Wave heights in the bay are 0.6 feet under Alternative 1 and 1.4 feet under no-action. An exception is at Little Pass Timbalier, where wave energy transmission into the bay is apparent.

Wave height reduction in Barataria Bay did occur on the lee side of the wave absorbers. Wave heights along northern Barataria Bay were projected to be 0.4 feet under no-action for 30- and 100-years. Alternative 1 produces an average wave height from 0.0 to 0.1 feet. The lower areas in Barataria Bay had wave heights of 0.0-0.1 feet for Alternative 1; however, the no-actin wave heights were only about 0.2-0.3 feet under no-action, which were below the criteria (10 centimeters wave height) set by the study team for mechanical erosion to occur.

6.2.6. Habitat Changes

As shown in Section 3.0, Figure 3-2, the 30-year no-action projection is overlain on the 1988/90 habitat data using the procedures described in Step H (LDNR 1998h.i). Figure 3-3 shows the same approach applied to the 100-year projection. The 30-year and 100-year projections for land-water associated with Alternative 1 are shown in Figures 6-4 and 6-5 respectively. They are also overlain on this habitat map. In addition, Figures 6-4 and 6-5 include habitats created along the barrier shorelines. Table 6-5 shows the difference in acreage of various emergent habitats for the 30- and 100-year no-action and Alternative 1 comparisons.

Table 6-5. Alternative 1 Habitat Distribution (acres)

	30-year No-Action	30-year Alternative 1	Change	100-year No-Action	100-year Alternative 1	Change
Water	1,489,569	1,465,492	-24,077	1,797,563	1,760,924	-36,639
AB floating	5,452	5,452	0	3,273	3,273	0
AB Submerged	4,207	4,210	3	2,237	2,242	5
Fresh marsh	325,923	325,920	-3	262,965	262,965	0
Intermediate marsh	92,214	92,214	0	71,056	71,056	0
Brackish marsh	158,908	158,873	-35	115,212	115,193	-19
Saline marsh	300,531	321,780	21,249	176,188	208,611	32,423
Cypress forest	155,989	155,989	0	135,377	135,377	0
Bottomland forest	144,050	144,050	0	133,399	133,399	0
Upland forest	15,139	15,163	24	13,413	13,473	60
Dead forest	234	234	0	125	125	0
Bottomland scrub	54,242	54,124	-118	45,177	45,476	299
Upland scrub	9,204	8,984	-220	5,646	5,855	209
Shore/flat	2,006	5,185	3,179	1,172	4,729	3,557
AG/pasture	177,232	177,358	126	173,795	173,927	132
Upland barren	749	625	-124	592	561	-31
Developed	72,983	72,983	0	71,467	71,467	0
Other	35	31	-4	11	16	5
TOTAL	3,008,667	3,008,667		3,008,668	3,008,668	

The most prominent change shown in Table 6-5 is the decrease in open water and the increase in saline marsh and shore/flat habitat. Minor changes in brackish marsh, upland barren and agricultural/pasture lands are associated with the overlay of the new barrier configurations on the existing National Wetlands Research Center (NWRC) categorized habitats. Changes in upland forest are probably associated with the prevention of loss (maintenance of shoreline integrity) in the Caminada-Moreau areas where the maritime forest habitat on the beach ridges are predicted to remain under Alternative 1.

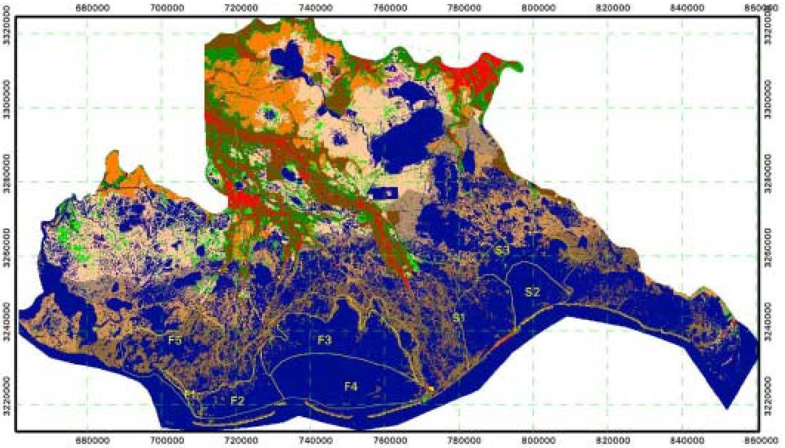
Due to the remnants of the barrier shorelines in the 30-year no-action projection (Figure 3-2), the effect of Alternative 1 on bay shoreline erosion is maximized under the 100-year projection - when all the existing barriers have eroded in the no-action scenario. It appears there is some scrub habitat at the bay shoreline, as may be expected along dredged material levees or perhaps natural levees. Under the 30-year comparison with Alternative 1 some of this is lost. However, some land loss in these polygons is prevented in 100-years, as the effect of Alternative 1 becomes more prominent against an increasing wave climate in no-action.

The net effect of Alternative 1, when compared to no-action, is an increase in saline marsh acreage by over 21,249 acres at 30 years. This increase in acreage is attributed to a 60-80% reduction in wave height along the marsh shoreline associated with the combined use of barrier restoration and wave absorbers. Shore/flat habitat (beach and dune in this case) increased by more than 3,557 acres. The distribution of these enhanced habitats can be seen by comparing Figures 3-2 and 3-3 with Figures 6-4 and 6-5. Apart from the barrier shoreline, the main effect of Alternative 1 is to maintain the marsh shoreline integrity on the landward side of the coastal bays. At present, Alternative 1 is not expected to have any other significant impact on interior marshes.

6.2.7. Faunal Impacts

Rebuilding barrier islands will increase dune area, beach, and marsh habitats compared to no action. Changes in salinity, connectivity, and depth are discussed for open bay, saline marsh, and brackish marsh habitats. There is little projected change in salinity, with the exception of a seasonal decrease up to 3 ppt on the backside of the barrier shoreline. Fragmentation and connectivity could be reduced as certain inlets are closed and land is created in open water.

Figure 6-4. Projected Coastal Habitat (30-year, Alternative 1)



Habitat	Area (Acres)
Water------------:	1465492
AB Floating-------:	5452
AB Submerged------:	4210
Fresh Marsh-------:	325920
Intermediate Marsh:	92214
Brackish Marsh----:	158873
Saline Marsh------:	321780
Cypress Forest----:	155989
Bottomland Forest-:	144050
Upland Forest-----:	15163
Dead Forest-------:	234
Bottomland Shrub--:	54124
Upland Shrub------:	8984
Shore/Flat-------:	5185
AG/Pasture-------:	177358
Upland Barren-----:	625
Developed--------:	72983
Other Land--------:	31

Prepared By NSEL/LSU, 1998

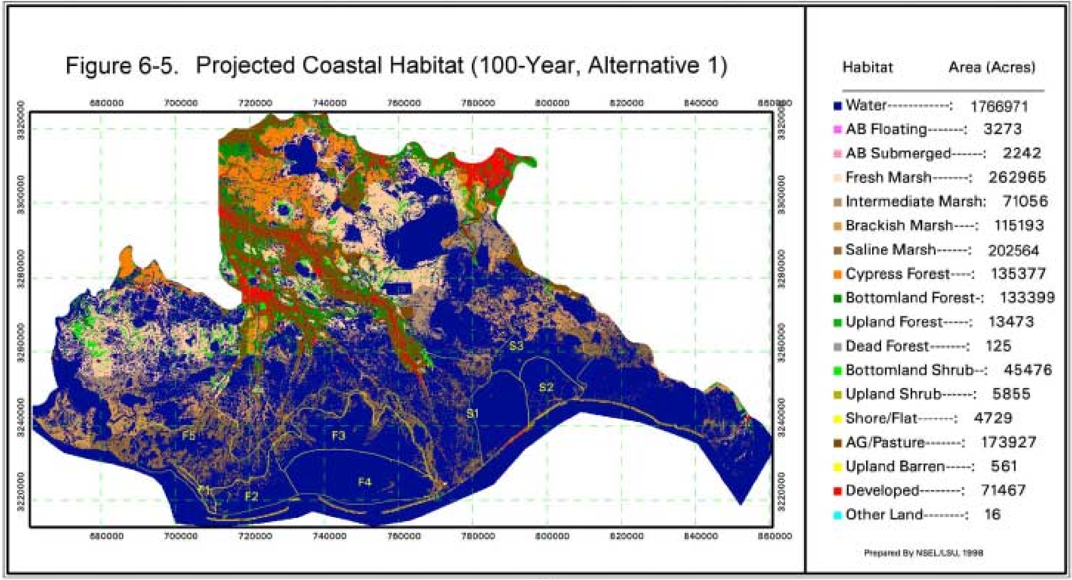


Figure 6-5. Projected Coastal Habitat (100-Year, Alternative 1)

Under the Alternative 1 projection, the system will not collapse as predicted under no-action. The barrier island ecosystem will still be functioning in the study area. Important implications for local fauna could be:

- high-energy beach habitat will serve as mating, pupping and nursery grounds for several species of sharks presently under a management plan designed to remedy a decline in population.
- high-energy beach habitat will serve as nursery area for species such as Florida pompano and Gulf Kingfish that have no alternate nursery habitat.
- beach and dune habitat will serve as nesting area for many species of shore and sea birds.
- scrub and wooded areas will serve as important stop over habitats for migrating songbirds (and other trans-Gulf migrators).
- barrier island marsh will serve as the initial nursery for many species of young-of-the-year/estuarine marine fish and macroinvertibrates that would otherwise move inland to mainland marshes.

The existing open bay environments expand through time at the expense of salt marsh habitats on the bay's north side. They are less open than under no-action. There is no change in their physiography compared to present. There may be a 3 ppt decrease in salinity at the southern margins of Timbalier Bay and in the Bay Long- Bastian Bay area. No change in salinity will occur close to the Gulf margin.

In addition, new open bays form as interior marsh deterioration continues, but the wave absorbers retain the bay shoreline integrity. These bays are connected to the existing bays and have slightly lower salinity. Their depth will likely be shallower than existing bays because of fetch limitations.

Decrease in open water acreage with Alternative 1 will probably mean little to the local fauna as compared to the no-action alternative. Losses in open water, and presumably a carrying capacity for the animals that used open water habitat, will not gain any capacity under Alternative 1 in comparison to the no-action scenario.

Within the salt marsh zone, many areas are presently fragmented (*e.g.*, Leeville to Fourchon area, marshes north of Lake Barre). They appear to make the transition to large open water areas by the 100-year projection, but remain separate from existing bays as described above. Salt marsh areas are fragmented in the 30-year projection. Those that remain at the 100-year projection are all fragmented. Fragmentation under Alternative 1 is similar to the no-action scenarios.

Although fragmentation is similar to the no-action conditions, Alternative 1 will result in a net increase in acreage of saline marsh, (*i.e.* not permitted to erode to open water) in comparison to the no-action alternative. Important implications for local fauna could be:

- increase in habitat available for many species of saline marsh residents, such as killifishes and gobies, that are important food items for many larger vertebrates (fish and birds) and invertebrates (blue crabs).
- increase in habitat available for many estuarine-marine transitory migrants, *i.e.* penaeid shrimp, blue crabs, spotted seatrout and red drum that use saline marsh as feeding and refuge areas during their first year of life.
- increase in important nesting habitat for many wading birds, seabirds, and certain ducks.

Presently, much of the brackish marsh zone has degraded to large open water areas (*e.g.* Montegut, Madison, Wonder Lake area). Under Alternative 1, the remaining brackish marsh areas increase in fragmentation. They do not, however, become connected to the bays as under no-action scenario.

In addition to providing protection for marsh habitats, the wave dampening devices will provide attachment potential for benthic invertebrates. It will also provide habitat heterogeneity for small species of both invertebrates and vertebrates. The wave absorbers will also shield the saline marsh-open water interface, a particularly important nursery habitat for many of the estuarine-marine species during their first year of life.

These changes in landscape will produce some changes in salinity patterns within the bay marsh systems. As interior wetlands deteriorate, the operation of the Davis Pond diversion allows lower salinity conditions to penetrate south into the Barataria Basin in conjunction with the Alternative 1 shoreline. The restored shoreline limits the amount of higher salinity water penetrating from the south. However, none of these changes are considered to be of sufficient magnitude to result in habitat shifts in the emergent marsh areas. Also, areas that were flooded by average tidal activity under no-action would also flood under the alternative; therefore, any changes in magnitude are not considered ecologically significant.

Similarly, for the faunal communities most of the changes in habitat are associated with the total amount of habitat of a certain type (e.g., shoreface habitat for sharks, marsh surface habitat for killifish, beach and dune habitat as nesting areas for species of shore and sea birds) rather than a change in habitat type. Importantly, the retention of some of these habitats, such as shoreface, through construction of Alternative 1, may be critical in relation to the projected loss under the no-action scenario.

6.2.8. Economic Resources

The economic resources analyzed for Alternative 1 include commercial and recreational fishing; increased hurricane surge flood potential for residential, commercial, and industrial infrastructure; agriculture; oil and gas infrastructure; water supply; and roads. The results were then compared to the future without project costs in Section 3.0.

6.2.8.1. Commercial and Recreational Fishing

Wetland acreage was assigned a dollar value representing the estimated worth to commercial and recreational fisheries. Under the future without project conditions, the annual wetlands losses were 4,828 acres per year for the first 30-years, and 2,686 acres per year for the remaining 70 years. Under Alternative 1, these rates have been reduced to 4,531 acres per year and 2,526 acres per year for 30- and 100-years respectively. As used in Section 3.0, the estimated commercial fishing marginal productivity values for each acre of salt marsh saved was $41.50 to $58.30 per acre was used. Using the same discount rate and marginal productivity value, the present value reduction in losses for Alternative 1 compared to no-action ranges from $0.136 to $0.190 million in 30-years and $0.142 to $0.200 million in 100-years.

In addition, the creation of new saline marsh at the barrier islands would add to the overall reduction in impact to commercial fishing. Using the same marginal productivity values above, the present value reduction of this impact ranges from $0.339 million and $0.476 million in 30- and 100-years.

The reduction in losses for recreational fishing compared to the future without project conditions has a present value of $0.539 to $0.602 million in 30-years and $0.704 to $0.843 million in 100-years. This is based on the estimated annual loss values of $60.72 to $64.40 per user, which was adjusted for the reduction in land loss. The commercial and recreational savings are shown in Table 6-6.

Table 6-6. Present and Annualized Values of Reductions in Commercial and Recreational Losses Attributable to Alternative 1 ($ millions)

		Discount Rate:	8.25%	8.25%
Alternative 1 Savings	Period (Years)	Low/High	Present Value	Annualized Value
Commercial Fishing	30	Low	$0.475	$0.042
		High	$0.666	$0.059
	100	Low	$0.481	$0.040
		High	$0.676	$0.055
Recreational Fishing	30	Low	$0.539	$0.049
		High	$0.602	$0.055
	100	Low	$0.704	$0.058
		High	$0.843	$0.069

6.2.8.2. Hurricane Flooding

The reduction in expected hurricane flood damage associated with Alternative 1 was analyzed using the identical storm intensity, tracks, and forward speed as the future without project condition. Expected flood damages to residential, commercial, industry and public structures, as well as roads, were estimated.

As shown in Table 6-7, the predicted total damages from the 90.5W prototype Category 5 storm occurring in 100-years under Alternative 1, using median depths, are $862 million compared to $939 million for future without project. Of particular interest is that implementing

Alternative 1 produces the same damage estimate at 100 years as the modeled storm will under current conditions. Alternative 1 results in a $77 million reduction in damages from this type of storm occurring in 100-years compared to no-action.

The predicted total damages from the 91.5W prototype Category 5 storm occurring in 100-years under Alternative 1, using median depths, are $742 million, compared to $879 million in damages for the future without project. This results in an expected $136 million reduction in storm damages. Additionally, the data show that Alternative 1 in 100-years will provide greater protection than the current topography provides today. The estimated impacts for 30-years were extrapolated from the estimated impacts in 100-years, shown in the last row of Table 6-7. The 30-year storm benefits will be used in comparing benefits and project costs.

Table 6-7. Median Flood Damages Under Two Prototype Storms for Alternative 1 ($millions)

	90.5W Storm	91.5W Storm
Present Storm Under Current Conditions	$862.361	$787.636
Damages in 100-years Under:		
No-action	$939.173	$878.862
Alternative 1	$862.103	$742.485
Damage in 100-years Under No-action MINUS Damage in 100-years Under Alternative 1	$77.070	$136.377
Damage in 30-years Under No-action MINUS Damage in 30-years Under Alternative 1	$23.121	$40.913

6.2.8.3. Oil and Gas Infrastructure

By constructing and maintaining Alternative 1, there is no predicted need to rebury pipelines that use the barrier shoreline as an anchor point. Therefore, the expected $1.2 million cost for reburial associated with the no-action alternative at years 30, 60, and 90 would not occur. Also, the number of pipelines that would require reburial would be reduced due to the reduction in interior wetland loss. The total present value savings due to implementation of Alternative 1 is $0.36 million for 30-years and $0.39 million in 100-years shown in Table 6-8.

Table 6-8. Pipeline Reburial Cost Savings from Alternative 1 ($ millions)

Losses Under	**MINUS** Losses Under	Period (Years)	Wetlands Loss Avoided	8.25% Present Value	Annualized Value
No-action	Alternative 1	30	6.2%	$ 0.36	$ 0.03
		100	6.0%	$ 0.39	$ 0.03

The cost to construct a platform in unprotected waters is at least double the cost for platforms in protected waters (LDNR 1998h.ii). Based on the number of new wells installed in the 1980's and the cost to build larger platforms due to the loss of the barrier islands and wetlands, the present value of these increased costs is $0.269 million over the 30-year period and $0.296 million over the 100-year period. It is assumed that by building and maintaining Alternative 1, the needed protection will be provided and these cost will be saved.

6.2.8.4. Highway and Street Maintenance

The hydrologic models did not yield substantially different flood risk margins for roads under no-action compared to Alternative 1. Because the risk margins were so small, no reasonable change in estimated damages associated with highway and street flooding could be made for Alternative 1.

6.2.8.5. Water Supply

Potential water supply problems were felt to be more closely associated with subsidence and sea level rise. Implementation of Alternative 1 will not affect those processes, and thus no beneficial impacts to water supply are expected.

6.2.8.6. Agricultural Crop Flood Damages

Implementation of Alternative 1 did not produce significant changes in flooding of agricultural lands. Thus, no significant benefits to that resource are expected.

6.2.8.7. Total Costs

The non-storm related reduction in costs for Alternative 1 compared to the future without project conditions is shown in Table 6-9. This includes commercial and recreational fishing, pipeline reburials, and cost savings to install new oil and gas wells. This table shows the present and annualized values of these costs, for 30 and 100-year periods using the 8.25% discount rate. Alternative 1 has non-storm present value cost reductions that range from $1.643 to $1.897 million in a 30-year period, and $1.844 and $2.178 million in 100-years compared to the future without project conditions.

Table 6-9. Summary of Non-Storm Cost Savings and Benefits of Project Alternative 1 Compared to No-action ($ millions)

Period (Years)	Low/ High	8.25% Present Value	8.25% Annualized Value
30	Low	$1.643	$0.145
	High	$1.897	$0.168
100	Low	$1.844	$0.152
	High	$2.178	$0.178

The estimated reductions in damages for a Category 5 Hurricane making landfall in the study area compared to the future without project conditions are shown in Table 6-10. These reductions are due to the hydrologic benefits provided by Alternative 1 and the wetlands preserved by this option in 30- and 100-years.

Table 6-10. Flood Damage Reductions Under Alternative 1 compared to future without project conditions ($ millions)

	90.5W Storm	91.5W Storm
Reduction in Damages in 100-years Under Alternative 1	$77.070	$136.377
Reduction in Damages in 30-years Under Alternative 1	$23.121	$40.913

6.2.9. Estimated Project Cost

A detailed discussion of engineering options and costs can be found in Step K - Identification and Assessment of Management and Engineering Techniques (LDNR 1998k). Alternative 1 includes constructing dunes and marsh platforms to increase the overall island width to approximately 1,970 feet. The dunes would provide elevation to island and prevent overwash from storm events. In the Step K report, various dune heights were considered and analyzed to determine whether a higher dune with less maintenance was more economical than building a lower initial dune height with more frequent maintenance. A dune height ranging from 7.0 to 9.0 feet was determined to be the most cost effective based on the analysis.

Similarly, the use of beach fill, shoreline armoring, and combinations of various coastal structures and beach fill were considered in the maintenance of alternatives. The methods for determining the maintenance is described in detail in Step K (LDNR 1998k).

For beach fills, a conservative estimate applying the historical shoreline erosion rate was used to determine the quantity of fill needed during each maintenance cycle to offset erosion and maintain the 1,970-foot project footprint. The combined use of beach fill and structures was analyzed based on the assumption that reductions in shoreline erosion might occur near these structures (LDNR 1998k). The use of revetments to armor the gulf shoreline was also considered. The shoreline would be armored and no beach fill would be included except to repair damages to the dunes. An estimate of storm damage to the revetment was developed to account for period storm events that would require periodic maintenance.

A second line of wave absorbers begins north of Wine Island Pass in Lake Pelto at the marsh fringe. This line of wave absorbers follows the southern end of Lake Barre and Lake Raccourci, down to Pierle Bay in the southeast corner of Timbalier Bay. Wave absorbers are also included along the fringing marshes surrounding Barataria Bay.

A five year maintenance program is included with options ranging from: 1) beach and dune renourishment (sand only), 2) repairing breakwaters and groins with beach and dune renourishment (sand and structures), and 3) repairing the revetment along the entire gulf shoreline with no beach renourishment (revetment). It is assumed that the maintenance of the projects would include beach fill and/or structural repair to offset erosion and damages that occur between maintenance periods. Under this program, the assumption is that the project footprint would be the same in 30-years as it would be after initial construction.

The primary source of island construction material is sand from the flood and ebb tidal deltas, assuming adequate quantities are available. Ship Shoal sand would be a secondary source for the Isles Dernieres and could potentially be the maintenance sand source. The location, estimated quantities, description, and analysis of sand sources are found in the Step K report (LDNR 1998).

Table 6-11 gives an itemized cost estimate for the Alternative 1 engineering options in each sub-area. The values shown in Table 6-11 have been slightly modified from the cost tables shown in the Step K report. In Step K, an item for advanced beach fill was included to provide more sand in the initial beach fill to offset erosion during the first maintenance period. The study team felt that this could be removed to reduce costs with no change to the benefits.

By adding the lowest costs in each sub-area together, as well as the highest costs, to develop a range of initial and maintenance costs. The initial project cost (the present funds needed to design and construct the initial construction of the project footprint) for Alternative 1 ranges from $486-$964 million for the Phase 1 Study Area. The annual maintenance cost (5-year periodic maintenance cost amortized at 8% for 30-years) for Alternative 1 ranges from $3.3-$83.3 million. The average annual costs represent the overall project cost including interest and amortization 8% for 30-years of the original investment and maintenance funding to preserve the 24.5 mi^2 of the original design template for 30-years.

The lowest average annual cost for Alternative 1 is $79.0 million. For the Isles Dernieres, this includes the combination of sand and coastal structures (breakwaters, jetties, revetment) with an average annual cost at $13.4 million. At the Timbalier Islands, the combination of sand and structures with a 5-year return period dune design has the lowest average annual cost at $19.6 million. The revetment option has the lowest average annual cost at

$9.1 million for the Caminada Moreau Headland. The revetment option has the lowest average annual cost of $34.1 million along the Plaquemines shoreline.

Table 6-11 Itemized Costs for Alternative 1

Location		Sand Only	Revetment	Sand and Structures
Isles Dernieres				
Island Construction only				
	Average Annual Cost	$12,215,099	$17,600,560	$10,976,488
	Initial Cost	$95,994,823	$194,249,943	$106,695,057
	Maintenance Cost	$3,688,166	$345,920	$1,499,087
Wave Absorbers (Structure only)				
	Average Annual Cost	$2,443,320	$2,443,320	$2,443,320
	Initial Cost	$24,344,761	$24,344,761	$24,344,761
	Maintenance Cost	$280,848	$280,848	$280,848
Timbalier Islands				
Island Construction only				
	Average Annual Cost	$16,018,283	$19,252,265	$15,985,597
	Initial Cost	$108,788,667	$212,452,701	$152,070,931
	Maintenance Cost	$6,354,913	$380,729	$2,477,593
Wave Absorbers (Structure only)				
	Average Annual Cost	$3,607,951	$3,607,951	$3,607,951
	Initial Cost	$35,865,054	$35,865,054	$35,865,054
	Maintenance Cost	$422,166	$422,166	$422,166
Caminada-Moreau Headland				
	Average Annual Cost	$49,673,765	$9,133,054	N/A
	Initial Cost	$19,958,942	$98,196,329	N/A
	Maintenance Cost	$47,900,872	$410,574	N/A
Plaquemines Shoreline				
Island Construction only				
	Average Annual Cost	$39,808,133	$34,144,866	N/A
	Initial Cost	$174,054,035	$371,986,983	N/A
	Maintenance Cost	$24,347,435	$1,102,378	N/A
Wave Absorbers (Structure only)				
	Average Annual Cost	$2,738,163	$2,738,163	N/A
	Initial Cost	$27,261,291	$27,261,291	N/A
	Maintenance Cost	$316,624	$316,624	N/A

LOWEST PROJECT COST		
	Average Annual Cost	**$79,029,439**
	Initial Cost	**$816,420,406**
	Maintenance Cost	**$6,509,270**

6.3. Alternative 2

A description of Alternative 2 is found in Chapter 5. Alternative 2 is a major barrier shoreline restoration option providing habitat and a protective gulf shoreline extending 76.6 miles.

6.3.1. Physical Conditions

By constructing Alternative 2, 9,904 acres (15.5 mi^2) (Table 6-12) of wetlands and island habitat on the islands would be created. Alternative 2 does not include the wave absorbers, unlike Alternative 1. Alternative 2 would be maintained on a 5-year cycle.

Table 6-12. Acres of Emergent habitats associated with Construction of Alternative 2

Island habitat	
Beach	2.414
Vegetated Dune	974
Saline Marsh	6,516
Total Land	**9,904**

In addition to the above effect, the construction of Alternative 2 would prevent the loss of 780 acres (1.2 mi^2) of bay shoreline marsh in 30-years and 8,851 acres (13.8 mi^2) in 100-years compared to the future without project. The majority of the land loss prevented is saline marsh and shore/flat habitat in Terrebonne Bay. The habitats benefited by Alternative 2 are discussed in Section 6.3.5.

6.3.2. Tides

The tidal simulations project that the Alternative 2 will have an overall effect of slightly decreasing tidal amplitude in the study area. Table 6-13 indicates that for 11 sites that are flooded currently, eight sites will experience a decrease, while three sites will remain unchanged.

Table 6-13. Alternative 2 Changes in water level for future projections. X = no change or not flooded. V = flooded and/or change in water level, NC = no change from no action, D =decrease from no action.

Station Name	No-action		Alternative 2	
	30 yr	100 yr	30 yr	100 yr
Venice	V	V	NC	NC
Port Sulphur	X	V	X	D
St. Mary's Point	V	V	D	NC
Lafitte	X	X	X	X
Bayou Perot (S)	V	V	NC	NC
Lake Salvador	V	V	D	D
Leeville	V	V	NC	NC
Golden Meadow	X	X	X	X
Bully Camp	X	V	X	D
Caillou Island	V	V	D	D
Lac des Allemands	V	V	D	D
Madison Canal	X	X	X	X
Cocodrie	X	V	X	X
Falgout Canal[1]	V	V	NC	D
HNC at GIWW	V	V	NC	D
Minors Canal	V	X	NC	D
Sister Lake	V	V	NC	NC
Jug Lake	V	V	NC	NC
Lost Lake	X	X	X	X
Bayou Penchant (W)	X	X	X	X
Amelia	X	X	X	X

Figure 6-1 shows that Alternative 2 does not have a significant impact on tidal amplitudes at St. Mary's Point for present conditions. The tidal simulations for the 30- and 100-year configurations (Figures 6-2 and 6-3) project a tidal amplitude of 5.1 inches for Alternative 2 compared to 6.1 inches and 4.7 inches in 30- and 100-years under no-action.

6.3.3. Salinity

The results of the salinity simulations indicate the effects of Alternative 2 are generally restricted to areas adjacent to the islands and have patterns similar to Alternative 1. For year 30, the salinity differences for Alternative 2 are greatest north of Timbalier Island where salinity decreases by about 3 ppt. Decreases in salinity also are indicated in Barataria Bay north of Grand Terre and in Caillou Bay north of Isles Dernieres. The salinity decreases are 1 to 2 ppt. Salinity seaward of the barriers shows a slight increase by about 1 ppt due to the barrier islands limiting exchange along the gulfside of the island. For year 100, the salinity changes are much less noticeable.

When combined with the Davis Pond diversion, Alternative 2 does have a large impact in Barataria Bay. Most of the southern part of Barataria Bay is projected to experience a decrease in salinity of 3 ppt similar to Alternative 1. A detailed discussion on the salinity impacts of Alternative 2 is found in the Step J report (LDNR 1999j).

6.3.4. Hurricane Surge

The results of the hurricane simulations indicate that Alternative 2 generally reduces flooding in the study area. The maximum flood elevations for the various time series locations are summarized in Tables 6-14 and 6-15. These tables depict the maximum flood elevation averaged between the present, 30- and 100-year periods due to the surge elevation for Alternative 2 and no-action. The decreases in surge height and areas flooded are used to analyze the economic benefits due to decreased flooding.

Table 6-14. Average* maximum flood elevation for the Track 1 hurricane (feet) – Alt. 2

Location	No-action	Alternative 2
Bully Camp	5.90	4.25
Caillou Island	4.60	3.10
Cocodrie	3.80	3.75
Golden Meadow	5.90	5.60
Lafitte	9.00	7.20
Lake Salvador	3.95	2.60
Leeville	6.90	5.25
Port Sulphur	10.80	7.85
St. Mary’s Point	7.90	5.60
South Bayou Perot	6.55	5.60
Venice	4.40	4.10

* Average of present, 30- and 100-year

Table 6-15. Average[*] maximum flood elevation for the Track 2 hurricane (feet) – Alt. 2

Location	No-action	Alternative 2
Amelia	8.70	8.35
Bully Camp	10.65	9.20
Bayou Penchant	8.00	8.00
Cocodrie	9.50	8.20
Falgout Canal	9.85	8.85
Golden Meadow	5.40	5.40
Houma Navigation Canal	11.15	10.65
Jug Lake	11.00	10.35
Lafitte	5.90	4.90
Lac des Allemands	7.55	6.40
Lake Salvador	6.05	5.25
Leeville	5.10	4.25
Lost Lake	9.85	9.20
Madison Canal	8.85	7.55
Minor's Canal	11.30	10.50
Port Sulphur	5.10	4.10
Sister Lake	11.30	10.35
South Bayou Perot	5.10	4.10

* Average of present, 30- and 100-year

6.3.5. Waves

Under fair-weather wave conditions, waves approaching from the south are significantly reduced in height in the immediate lee of the restored barriers and where breaches are closed (Area 1). Under Alternative 2, waves in Caillou Bay do not exceed 0.3 to 0.7 feet, except through Whiskey Pass where average wave heights are 1.3 feet. The spatially averaged wave height in Caillou Bay is 0.5 feet, which is relatively the same as for no-action in 30- and 100-years. In Lake Pelto, the average wave height along the marsh shoreline is approximately 0.5 feet compared to 0.6 and 1.3 feet for no-action in 30- and 100-years respectively.

In Terrebonne-Timbalier Bays (Area 2), The effects of Alternative 2 are only found near the islands and inlets. In 30-years, the average wave height along the shoreline is 0.3 feet for both Alternative 2 and no-action. In 100-years, the average wave height along the marsh shoreline is 0.4 feet under Alternative 2 compared to 0.5 feet for no-action. During this same period, the average wave height in the bays is approximately 0.7 feet for Alternative 2 and 1.4 feet for no-action.

In Barataria Bay, the main impacts of Alternative 2 on wave climate are near the islands and slightly along the eastern marsh shoreline in the bay. The projected average wave height in Barataria Bay is 0.4 feet under no-action and Alternative 2 in 30 years. Slight increases in the 100-year no-actin projection are seen compared to no-action, but fall below the 10-centimeter threshold the study team established for causing mechanical erosion.

6.3.6. Habitat Changes

As shown in Section 3.0 in Figure 3-2, the 30-year no-action projection is overlain on the 1988/90 habitat data using the procedures described in Step H (LDNR 1998h.i). Figure 3-3 shows the same approach applied to the 100-year projection. The 30-year and 100-year projections for land-water associated with Alternative 2 are shown in Figures 6-6 and 6-7 respectively. They are also overlain on this habitat map. In addition, Figures 6-6 and 6-7 include habitats created along the barrier shorelines. Table 6-16 shows the difference in acreage of various emergent habitats for the 30- and 100-year no-action and Alternative 2 comparisons.

The most prominent change shown in Table 6-16 is the decrease in open water and the increase in saline marsh and shore/flat habitat. Minor changes in brackish marsh, upland barren and agricultural/pasture lands are associated with the overlay of the new barrier configurations on the existing National Wetlands Research Center (NWRC) categorized habitats. Changes in upland forest are probably associated with the prevention of loss (maintenance of shoreline integrity) in the Caminada-Moreau areas where the maritime forest habitat on the beach ridges are predicted to remain under Alternative 2.

Due to the remnants of the barrier shorelines in the 30-year no-action projection (Figure 3-2), the effect of Alternative 2 on bay shoreline erosion is maximized under the 100-year projection - when all the existing barriers have eroded in the no-action scenario. It appears there is some scrub habitat at the bay shoreline, as may be expected along dredged material levees or perhaps natural levees. Under the 30-year comparison with Alternative 2 some of this is lost. However, some land loss in these polygons is prevented in 100-years, as the effect of Alternative 2 becomes more prominent against an increasing wave climate.

Table 6-16. Alternative 2 Habitat Distribution (acres)

	30-year No-Action	30-year Alternative 2	Change	100-year No-Action	100-year Alternative 2	Change
Water	1,489,569	1,479,882	-9,688	1,797,563	1,778,441	-19,123
AB floating	5,452	5,452	0	3,273	3,273	0
AB Submerged	4,207	4,209	2	2,237	2,242	5
Fresh marsh	325,923	325,916	-7	262,965	262,960	-5
Intermediate marsh	92,214	92,214	0	71,056	71,056	0
Brackish marsh	158,908	158,886	-22	115,212	115,193	-19
Saline marsh	300,531	307,827	7,296	176,188	191,555	15,367
Cypress forest	155,989	155,989	0	135,377	135,377	0
Bottomland forest	144,050	144,050	0	133,399	133,399	0
Upland forest	15,139	15,139	0	13,413	13,466	53
Dead forest	234	234	0	125	125	0
Bottomland scrub	54,242	54,110	-132	45,177	45,459	282
Upland scrub	9,204	8,958	-246	5,646	5,779	133
Shore/flat	2,006	4,855	2,849	1,172	4,443	3,271
AG/pasture	177,232	177,310	78	173,795	173,883	88
Upland barren	749	632	-117	592	560	-32
Developed	72,983	72,973	-10	71,467	71,442	-25
Other	35	32	-3	11	16	5
TOTAL	3,008,667	3,008,667		3,008,668	3,008,668	

The net effect of Alternative 2, when compared to no-action, is an increase in marsh acreage of 7,296 acres in 30 years. This increase in acreage is attributed to a reduction in land loss rate is due to the barrier restoration of Alternative 2. Shore/flat habitat (beach and dune in this case) increased by more than 2,849 acres. The distribution of these enhanced habitats can be seen by comparing Figures 3-2 and 3-3 with Figures 6-6 and 6-7. Apart from the barrier shoreline, the main effect of Alternative 2 is to maintain the marsh shoreline integrity on the landward side of the coastal bays. Alternative 2 is not expected to have any other significant impact on interior marshes.

Figure 6-6. Projected Coastal Habitat (30-Year, Alternative 2)

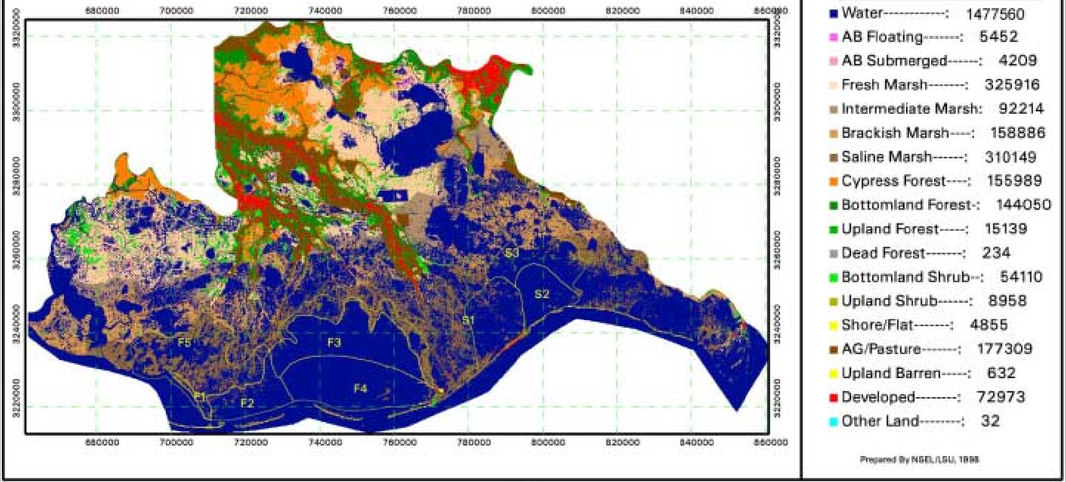
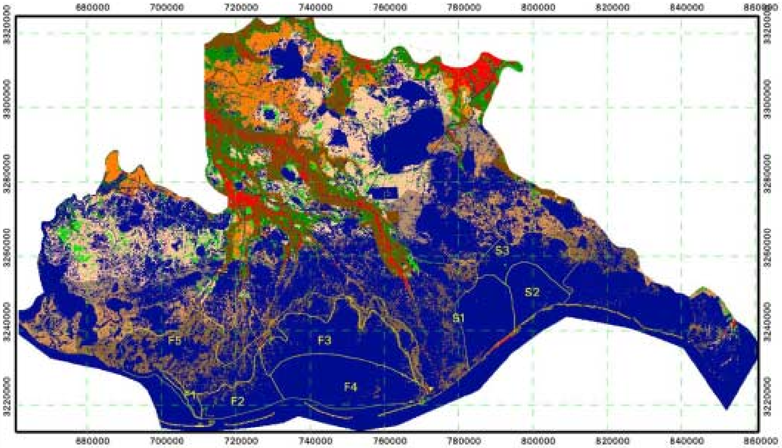


Figure 6-7. Projected Coastal Habitat (100-Year, Alternative 2)



Habitat	Area (Acres)
Water	1784307
AB Floating	3273
AB Submerged	2242
Fresh Marsh	262960
Intermediate Marsh	71056
Brackish Marsh	115193
Saline Marsh	185689
Cypress Forest	135377
Bottomland Forest	133399
Upland Forest	13466
Dead Forest	125
Bottomland Shrub	45459
Upland Shrub	5779
Shore/Flat	4443
AG/Pasture	173883
Upland Barren	560
Developed	71442
Other Land	16

Prepared By NSEL/LSU, 1998

6.3.7. Faunal Impacts

Rebuilding barrier islands will increase dune area, beach, and marsh habitats compared to no action. Changes in salinity, connectivity, and depth are discussed for open bay, saline marsh, and brackish marsh habitats. There is little predicted change in salinity, with the exception of a decrease of 3 ppt on the backside of the barrier shoreline. Fragmentation and connectivity could reduce as certain inlets are closed and land is created in open water.

Under the Alternative 2 projection, the system will not collapse as predicted under no-action. The barrier island ecosystem will still be functioning in the study area. Important implications for local fauna could be:

- high-energy beach habitat will serve as mating, pupping and nursery grounds for several species of sharks presently under a management plan designed to remedy a decline in population.
- high-energy beach habitat will serve as nursery area for species such as Florida pompano and Gulf Kingfish that have no alternate nursery habitat.
- beach and dune habitat will serve as nesting area for many species of shore and sea birds.
- scrub and wooded areas will serve as important stop over habitats for migrating songbirds (and other trans-Gulf migrators).
- barrier island marsh will serve as the initial nursery for many species of young-of-the-year/estuarine marine fish and macroinvertibrates that would otherwise move inland.

The existing open bay environments expand through time at the expense of salt marsh habitats on the bay's north side. They are less open than under no-action. There is little change in their physiography compared to present. There may be a <3 ppt decrease in salinity at the southern margins of Timbalier Bay and in the Bay Long- Bastian Bay area. Little change in salinity will occur close to the Gulf margin.

In addition, new open bays form as interior marsh deterioration continues. These bays are connected to the existing bays and have slightly lower salinity. Their depth will likely be shallower than existing bays because of fetch limitations.

Decrease in open water acreage with Alternative 2 will probably mean little to the local fauna as compared to the no-action alternative. Losses in open water, and presumably a carrying capacity for the animals that used open water habitat, will not gain any capacity under Alternative 2 in comparison to the no-action scenario.

Within the salt marsh zone, many areas are presently fragmented (*e.g.*, Leeville to Fourchon area, marshes north of Lake Barre). They appear to make the transition to large open water areas by the 100-year projection, but remain separate from existing bays as described above. Salt marsh areas are fragmented by the 30-year projection. Those that remain at the 100-year projection are all fragmented. Fragmentation under Alternative 2 is similar to the no-action scenarios.

Although fragmentation is similar to no-action conditions, Alternative 2 will result in a net increase in acreage of saline marsh, (*i.e.* not permitted to erode to open water) in comparison to the no-action alternative. Important implications for local fauna could be:

- increase in habitat available for many species of saline marsh residents, such as killifishes and gobies, that are important food items for many larger vertebrates (fish and birds) and invertebrates (blue crabs).
- increase in habitat available for many estuarine-marine transitory migrants, *i.e.* penaeid shrimp, blue crabs, spotted seatrout, red drum that use saline marsh as feeding and refuge areas during their first year of life.
- increase in important nesting habitat for many wading birds, seabirds, and certain ducks.

Presently, much of the brackish marsh zone has degraded to large open water areas (*e.g.* Montegut, Madison, Wonder Lake area). Under Alternative 2, the remaining brackish marsh areas increase in fragmentation. They do not, however, become connected to the bays as under no-action.

These changes in landscape will produce changes in salinity patterns within the bay marsh systems. As interior wetlands deteriorate in the future, the Davis Pond diversion allows lower salinity conditions to penetrate south into the Barataria Basin in conjunction with the Alternative 2 shoreline. The restored shoreline limits the amount of higher salinity water penetrating from the south. However, none of these changes are considered to be of sufficient magnitude to result in habitat shifts in the emergent marsh areas. Also, areas that were flooded by average tidal activity under no-action would also flooded under the alternative; therefore, any changes in magnitude are not considered ecologically significant.

Similarly, for the faunal communities most of the changes in habitat are associated with the amount of habitat of a certain type (e.g., shoreface habitat for sharks, marsh surface habitat for killifish, beach and dune habitat as nesting areas for species of shore and sea birds) rather than a change in habitat type. Importantly, the retention of some of these habitats, such as shoreface, through construction of Alternative 2, may be critical in relation to the projected loss under the no-action scenario.

6.3.8. Economic Resources

The economic resources analyzed for Alternative 2 include commercial and recreational fishing; increased hurricane surge flood potential for residential, commercial, and industrial infrastructure; agriculture; oil and gas infrastructure; water supply; and roads. The results were then compared to the future without project costs in Section 3.0.

6.3.8.1. Commercial and Recreational Fishing

As was done for Alternative 1, wetland acreage was assigned a dollar value representing the estimated worth to commercial and recreational fisheries. Under the future without project conditions, the annual wetlands losses were 4,828 acres per year for the first 30-years, and 2,686 acres per year for the remaining 70 years. Under Alternative 2, these rates have been reduced to 4,802 acres per year and 2,560 acres per year for 30- and 100-years respectively. As used in Section 3.0, the estimated commercial fishing marginal productivity values for each acre of salt marsh saved was $41.50 to $58.30 per acre was used. Using the same discount rate and cost of losing one acre of land, the present value reduction in losses for Alternative 2 compared to no-action ranges from $0.011 to $0.016 million in 30-years and $0.016 to $0.023 million in 100-years.

In addition, the creation of new saline marsh at the barrier islands would add to the overall reduction in cost of commercial fishing. Using the same marginal productivity values above, the present value reduction of this impact ranges from $0.180 million and $0.252 million in 30- and 100-years.

The reduction in losses for recreational fishing compared to the future without project conditions has a present value of $0.269 to $0.301 million in 30-years and $0.352 to $0.422 million in 100-years. This is based on the estimated annual loss values of $57.04 to $61.64 per user, which was adjusted for the reduction in land loss. The commercial and recreational savings are shown in Table 6-17.

Table 6-17. Present and Annualized Values of Reductions in Commercial and Recreational Losses Attributable to Alternative 2 ($ millions)

		Discount Rate:	8.25%	8.25%
Alternative 2	Period		Present	Annualized
Savings	(Years)	Low/High	Value	Value
Commercial Fishing	30	Low	$0.191	$0.017
		High	$0.268	$0.024
	100	Low	$0.196	$0.016
		High	$0.275	$0.023
Recreational Fishing	30	Low	$0.269	$0.025
		High	$0.301	$0.028
	100	Low	$0.352	$0.029
		High	$0.422	$0.035

6.3.8.2. Hurricane Flooding

The reduction in expected hurricane flood damage associated with Alternative 2 was analyzed using the identical storm intensity, tracks, and forward speed as the future without project condition and Alternative 1. Expected flood damages to residential, commercial, industry and public structures, as well as roads, were estimated.

As shown in Table 6-18, the predicted total damages from the 90.5W prototype Category 5 storm occurring in 100-years under Alternative 2, using median depths, are $903 million compared to $939 million for future without project. Alternative 2 results in a $36 million reduction in damages from this type of storm occurring in 100-years compared to no-action.

The predicted total damages from the 91.5W prototype Category 5 storm occurring in 100-years under Alternative 2, using median depths, are $804 million, compared to $879 million in damages for the future without project. This results in an expected $75 million reduction in storm damages. The estimated impacts for 30-years were extrapolated from the estimated impacts in 100-years, shown in the last row of Table 6-7.

Table 6-18. Median Flood Damages Under Two Prototype Storms for Alternative 2 ($ millions)

	90.5W Storm	91.5W Storm
Present Storm Under Current Conditions	$862.361	$787.636
Damages in 100-years Under:		
No-action	$939.173	$878.862
Alternative 2	$902.710	$804.076
Damage in 100-years Under No-action MINUS Damage in 100-years Under Alternative 2	$36.463	$74.795
Damage in 30-years Under No-action MINUS Damage in 30-years Under Alternative 2	$10.939	$22.439

6.3.8.3. Oil and Gas Infrastructure

By constructing and maintaining Alternative 2, there will be no projected need to rebury pipelines that use the barrier islands as an anchor point. Therefore, the expected $1.2 million cost for reburial associated with the no-action alternative at years 30, 60, and 90 would not occur. Also, the number of pipelines that would require reburial would be reduced due to the reduction in interior wetland loss. The total present value savings for pipeline reburial costs due to implementation of Alternative 2 is $0.13 million for 30-years and $0.24 million in 100-years shown in Table 6-19.

Table 6-19. Pipeline Reburial Cost Savings from Alternative 2 ($ millions)

Losses Under	**MINUS** Losses Under	Period (Years)	Wetlands Loss Avoided	8.25% Present Value	Annualized Value
No-action	Alternative 2	30	0.5%	$ 0.13	$ 0.01
		100	2.7%	$ 0.24	$ 0.02

The cost to construct a platform in unprotected waters is at least double the cost for platforms in protected waters (Step H.ii. 1998). Based on the number of new wells installed in the 1980's and the cost to build larger platforms due to the loss of the barrier islands and wetlands, the present value of these increased costs is $0.269 million over the 30-year period and $0.296 million over the 100-year period. It is assumed that by building and maintaining Alternative 2, the needed protection will be provided and these cost will be saved.

6.3.8.4. Highway and Street Maintenance

The hydrologic models did not yield substantially different flood risk margins for roads under no-action compared to Alternative 2. Because the risk margins were so small, no reasonable change in estimated damages associated with highway and street flooding could be made for Alternative 2.

6.3.8.5. Water Supply

Potential water supply problems were felt to be more closely associated with subsidence and sea level rise. Implementation of Alternative 2 will not affect those processes, and thus no beneficial impacts to water supply are expected.

6.3.8.6. Agricultural Crop Flood Damages

Implementation of Alternative 1 did not produce significant changes in flooding of agricultural lands. Thus, no significant benefits to that resource are expected.

6.3.8.7. Total Costs

The non-storm related reduction in costs for Alternative 2 compared to the future without project conditions is shown in Table 6-20. This includes commercial and recreational fishing, pipeline reburials, and cost savings to install new oil and gas wells. This table shows the present and annualized values of these costs, for 30 and 100-year periods using the 8.25% discount rate. Alternative 2 has non-storm present value cost reductions that range from $0.86 to $0.97 million in a 30-year period, and $1.06 and $1.21 million in 100-years compared to the future without project conditions.

Table 6-20. Summary of Non-Storm Cost Savings and Benefits of Project Alternative 2 Compared to No-action ($ millions)

Period (Years)	Low/ High	8.25% Present Value	8.25% Annualized Value
30	Low	$ 0.859	$ 0.076
	High	$ 0.968	$ 0.086
100	Low	$ 1.057	$ 0.089
	High	$ 1.206	$ 0.102

The estimated reductions in damages for a Category 5 Hurricane making landfall in the study area compared to the future without project conditions are shown in Table 6-21. These reductions are due to the hydrologic benefits provided by Alternative 2 and the wetlands preserved by this option in 30- and 100-years.

Table 6-21. Flood Damage Reductions Under Alternative 2 compared to future without project conditions ($ millions)

	90.5W Storm	91.5W Storm
Reduction in Damages in 100-years Under Alternative 2	$36.463	$74.795
Reduction in Damages in 30-years Under Alternative 2	$10.939	$22.439

6.3.9. Estimated Project Cost

A detailed discussion of engineering options and costs can be found in Step K - Identification and Assessment of Management and Engineering Techniques (LDNR 1998k). Similar to Alternative 1 described in Section 6.2.9, Alternative 2 includes constructing dunes and marsh platforms, but only increases the overall island width to approximately 1,230 feet. In addition, Alternative 2 does not have wave absorbers along the bay shorelines, which were part of Alternative 1. Based on the same preliminary dune analysis in Step K, dune heights ranging from 7.0 to 9.0 feet were determined to be the most cost effective based on the analysis.

The use of beach fills, shoreline armoring, and combinations of various coastal structures and beach fill were also considered in the maintenance of alternatives. The methods for determining the maintenance are the same for Alternatives 1 and 2 are described in detail in Step K (LDNR 1998k).

A five year maintenance program is included with options ranging from: 1) beach and dune renourishment (sand only), 2) repairing breakwaters and groins with beach and dune renourishment (sand and structures), and 3) repairing the revetment along the entire gulf shoreline with no beach renourishment (revetment). The assumption is that the initial footprint constructed would remain in 30-yeasr due to the periodic maintenance program.

The primary source of island construction material is sand from the flood and ebb tidal deltas, assuming adequate quantities are available. Ship Shoal sand would be a secondary source for the Isles Dernieres and could potentially be the maintenance sand source. The location of the borrow areas varies slightly between Alternatives 1 and 2. The location, estimated quantities, description, and analysis of sand sources are found in the Step K report (LDNR 1998).

Table 6-22 contains an itemized cost estimate for the Alternative 2 engineering options for each sub-area. The values shown in Table 6-22 have been slightly modified from the cost tables shown in the Step K report to remove the advanced beach fill cost (See Sect. 6.2.9).

Using the lowest and highest costs from Table 6-22, the range of initial project costs for Alternative 2 is \$286-\$730 million for the Phase 1 Study Area. The annual maintenance cost (5-year periodic maintenance cost amortized at 8% for 30-years) for Alternative 2 ranges from \$2.2-\$80.6 million. The overall project costs shown as the average annual costs (including interest and amortization 8% for 30-years) of the original investment and provide maintenance funding to preserve the 15.5 mi^2 of the original design template for 30-years.

The lowest average annual cost for Alternative 2 is \$56.6 million. For the Isles Dernieres, the combination of sand and coastal structures (breakwaters, jetties, revetment) with a 5-year return period dune design has the lowest average annual cost at \$10.7 million. At the

Timbalier Islands, the combination of sand and structures with a 5-year return period dune design has the lowest average annual cost at $9.9 million. The revetment option has the lowest average annual cost at $9.1 million for the Caminada Moreau Headland. The revetment option has the lowest average annual cost of $26.8 million along the Plaquemines shoreline.

Table 6-22 Itemized Costs for Alternative 2

Location		Sand Only	Revetment	Sand and Structures
Isles Dernieres				
	Average Annual Cost	$12,025,997	$16,851,964	$10,694,281
	Initial Cost	$90,203,141	$185,229,408	$101,240,717
	Maintenance Cost	$4,013,523	$398,591	$1,701,372
Timbalier Islands				
	Average Annual Cost	$12,267,292	$14,224,835	$9,907,213
	Initial Cost	$71,341,747	$156,304,289	$92,484,846
	Maintenance Cost	$5,930,219	$340,794	$1,692,062
Caminada-Moreau Headland				
	Average Annual Cost	$49,673,765	$9,133,054	N/A
	Initial Cost	$19,958,942	$98,196,329	N/A
	Maintenance Cost	$47,900,872	$410,574	N/A
Plaquemines Shoreline				
	Average Annual Cost	$32,019,985	$26,819,987	N/A
	Initial Cost	$104,788,177	$290,275,824	N/A
	Maintenance Cost	$22,711,966	$1,035,656	N/A
LOWEST PROJECT COST				
	Average Annual Cost	**$56,554,535**		
	Initial Cost	**$582,197,716**		
	Maintenance Cost	**$4,839,664**		

6.4. Summary

The results of the landscape mapping and hydrologic simulations indicate that the barrier island restoration alternatives will have a measurable effect on several environmental conditions in the study area. The acreage of saline marsh preservation associated with the barrier shoreline alternatives are 8,924 acres for Alternative 1 and 780 acres for Alternative 2 in 30-years. In addition, Alternative 1 includes the creation and maintenance of 12,325 acres of saline marsh and 3,305 acres of shore/flat habitat. Alternative 2 includes creation and maintenance of 6,516 acres of saline marsh and 3,388 acres of shore/flat habitat.

Tidal amplitude will not be significantly reduced in the bays or marshes of the study area due to the restoration Alternatives 1 and 2. Salinity simulations for both alternatives show that values in the bays of the study area will be reduced near the barrier islands, particularly near locations where tidal passes are closed or narrowed. The change in salinity is not enough to change the type of emergent habitat. The barrier alternatives show considerably larger effects in reducing salinity if the Davis Pond diversion is included in the simulations.

Both barrier alternatives reduce hurricane flooding in the study area. The reduction is highly variable in the study area and ranges from a few percent to up to 50% for Alternative 1 and from a few percent to up to 20% for Alternative 2. Charts showing the reduction in storm surge associated with Alternatives 1 and 2 for each storm track are shown in Figures 6-8 and 6-9.

Wave impacts at the marsh shoreline can be controlled by two means: 1) reducing the gaps between adjacent barrier islands, and 2) absorbing wave energy derived from locally-generated waves and/or longer period waves propagating through the tidal passes from the Gulf of Mexico. An optimal solution would be a combination of the above two, (*i.e.,* Alternative 1). Numerical modeling indicates that Alternative 2 would successfully reduce overall wave energy levels in the back-barrier bay, especially in the vicinity and directly landward of the previous gaps, by restricting wave propagation through these gaps. However, Alternative 2 does not provide any mitigation regarding the erosional impact of wind-generated waves inside the bay on

Figure 6-8. Average maximum flood elevation for the Track 1 hurricane

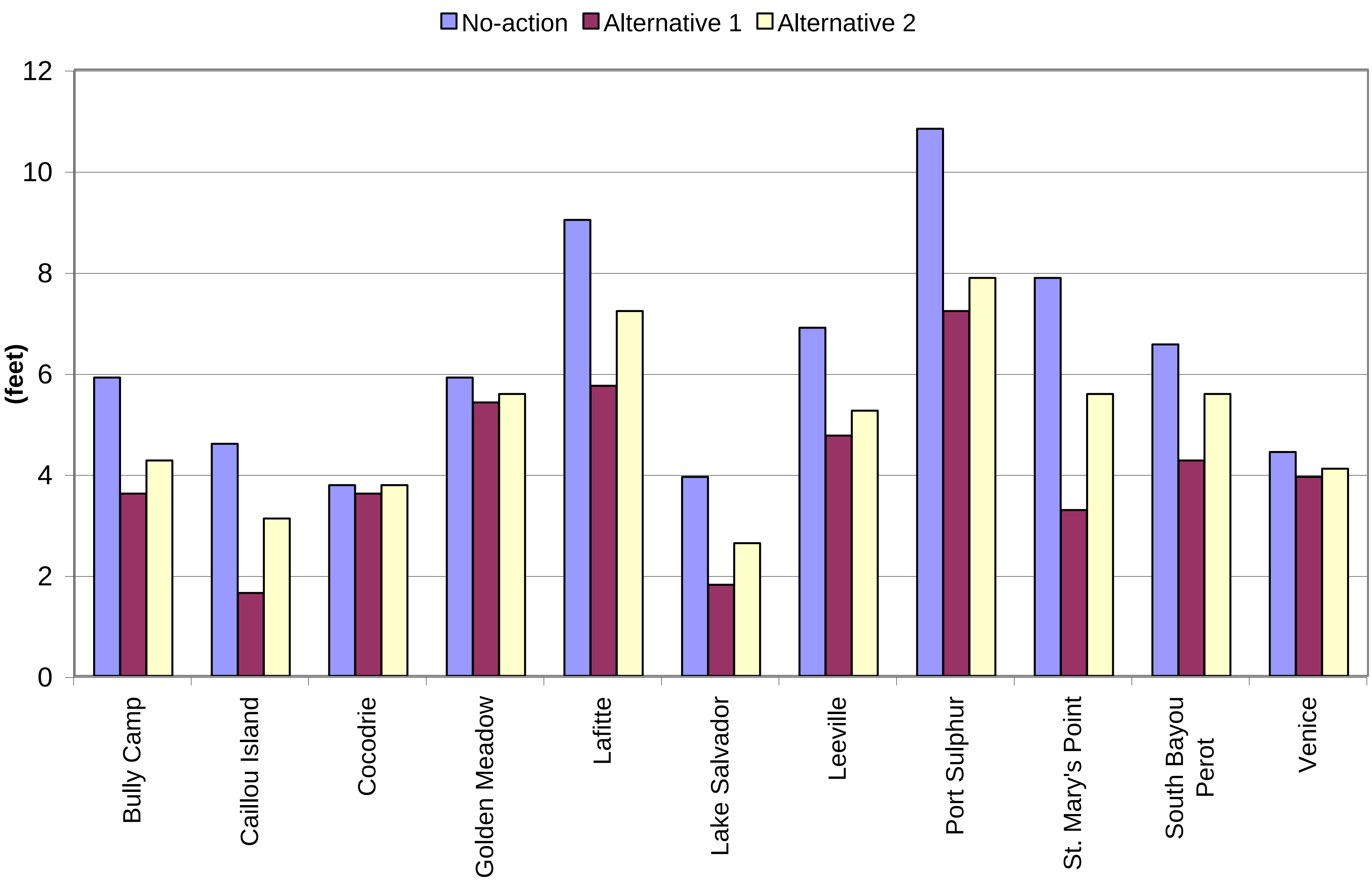
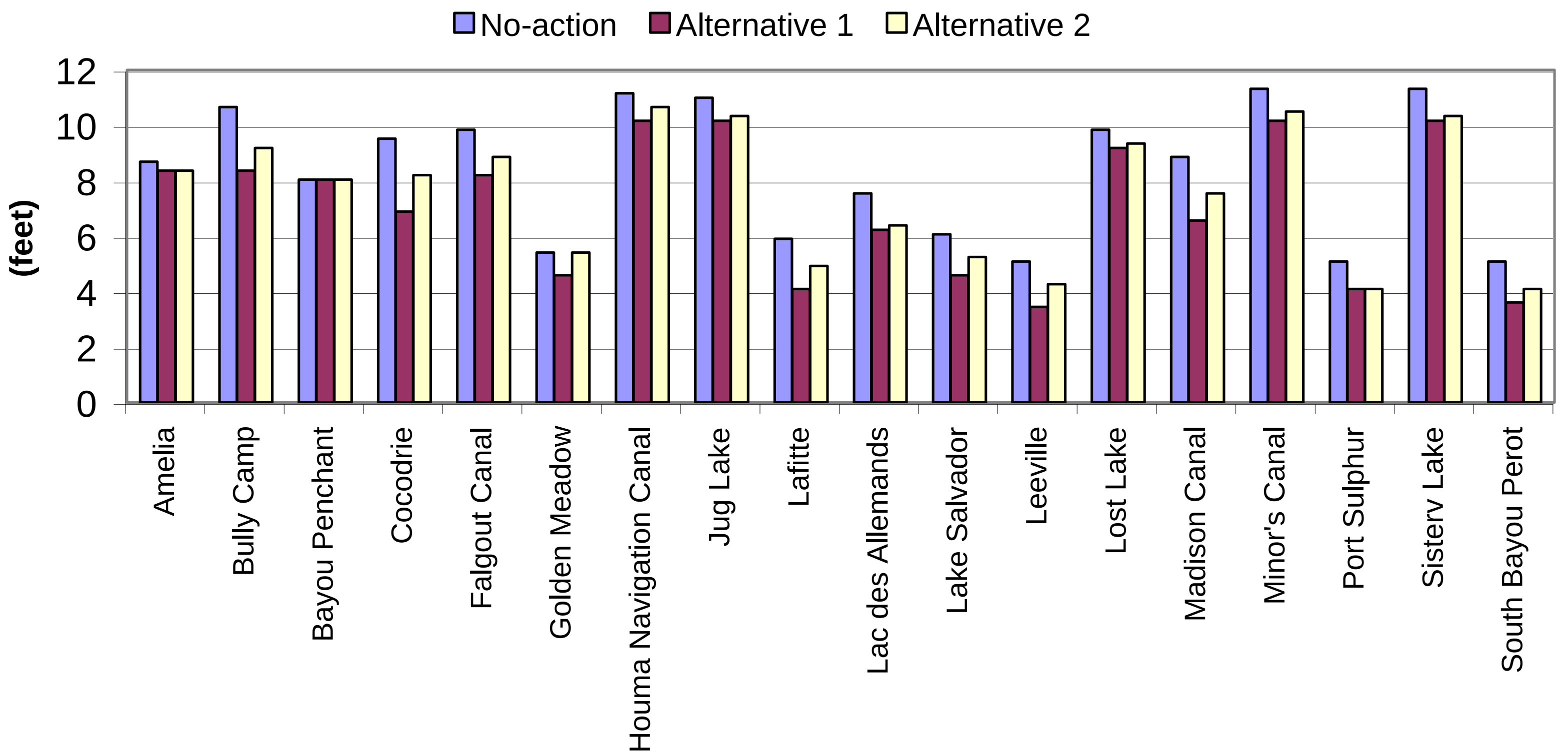


Figure 6-9. Average maximum flood elevation for the Track 2 hurricane



marsh shorelines. The data presented here indicate that Alternative 1, utilizing the nearshore wave energy absorbers, will protect the marsh shoreline more effectively in terms of dissipating between on average 80 and 100% of wave energy at the marsh-water interface around the bays. Although the numerical model predicts that Alternative 2 will reduce the potential for marsh shoreline erosion by significantly restricting wave energy, this solution does not offer any protection against wave generation in the bays driven by local winds.

Alternatives 1 and 2 directly impact open water areas, such as inlets and nearshore environments by converting them to marsh and shore/flat habitat. The beach habitat created and maintained with Alternatives 1 and 2 provides nursery grounds for many species of fish. The saline marsh created and maintained on the islands provides habitat for various estuarine fish and macroinvertebrates. The beach and dune provide nesting grounds for various species of non-migratory and migratory birds. Alternative 1 has an added benefit directly attributable to the wave absorbers. The interior set of segmented breakwaters provides hard bottom habitat and shelter for invertebrates and vertebrates.

The saline marsh along the landward bay shoreline protected by Alternatives 1 and 2 increases the habitat available for resident fish species. Estuarine and marine migrants use the marsh during their first year of life. Various species of birds will also use the marsh.

Three species of birds listed as threatened and endangered: the Brown Pelican, Piping Plover, and the Least Tern. Each could benefit from the preservation and creation of island

Expected flood damages to residential, commercial, industry and public structures, as well as to roads, were estimated. These expected damages took into consideration the probability that such a storm would occur. Damage costs were then compared across project alternatives using only a Category 5 storm for analysis. Lesser storms would also yield economic implications for the different project alternatives. For this reason alone, the estimated cost savings from the project alternatives must be interpreted as minimum savings. Losses to the commercial fishing industry and losses in recreational enjoyment were estimated, and the benefits of project alternatives compared for these losses. Oil and gas related losses, insofar as they could be estimated, were also compared across alternatives.

Alternative 1 reduces the flood damage in the study area by $77.1 million for a 90.5W storm track and $136.4 million for a 91.5W storm track compared to no-action in 100-years. Linearly interpolating these reductions yields benefits of $23.1 and $40.9 million compared with no-action in 30-years.

Alternative 2 reduces the flood damage in the study area by $36.5 million for a 90.5W storm track and $74.8 million for a 91.5W storm track compared to no-action in 100-years. Thus, flood damage benefits of Alternative 2 compared to no-action in 30-years is $10.9 and $22.4. By comparison, Alternative 1 provides approximately twice the flood damage savings as Alternative 2.

Non-storm losses to coastal Louisiana would stem from wetland losses, and associated recreational and commercial fishery losses. They would also stem from losses in the abilities of the barrier islands to protect oil and gas infrastructure. The present value of non-storm related cost savings or benefits from Alternative 1 compared to no-action range from $1.6 to $3.8 million over a 30-year period. The annualized values of these savings range from $145,000 to $188,000 per year. As in the case of storm damage protection, Alternative 2 provides approximately half the savings or benefits of Alternative 1. The present and annualized values of these savings and benefits increase using lower discount rates.

These economic benefits estimates will represent <u>minimum</u> benefits of the alternatives. Only one type of storm was considered. Considering a full range of storm types, along with their probabilities, would substantially <u>increase</u> benefits estimates of projects. There were no attempts to estimate migration costs if projects altered the need for populations to move. There was no reasonable way to predict what population responses to future hydrologic conditions would be. Recreational loss estimates may be a low if recreational demands in coastal Louisiana increase in the future. There were no estimates for the pain and suffering associated with increased storm vulnerability, or valuations of social losses in community and culture if populations were induced to migrate.

A summary of the benefits of the alternatives compared to no-action is shown in Table 6-23. The average annual cost for each alternative is based on the estimated project costs amortized for 30-years and includes all engineering, initial construction, maintenance, and contingency costs.

Table 6-23. Summary of Alternatives 1 and 2 Compared to No-action (30-years)

	Future Without Project	**Alternative 1**	**Alternative 2**
Saline marsh preserved 30-years	None	8,924 acres	780 acres
Saline marsh created and maintained	None	12,325 acres	6,516 acres
Dune and nearshore habitat created and maintained	None	3,305 acres	3,388 acres
Threatened and endangered species	3 bird species; 5 turtle species; No habitat created	Nesting and foraging habitat created for 3 bird species; Foraging habitat created for 5 turtle species	Nesting and foraging habitat created for 3 bird species; Foraging habitat created for 5 turtle species
Annualized non-storm savings	None	$145,000-188,000	$76,000-128,000
Storm damage savings in 30-years	None	$23-41 million	$11-22 million
Lowest average annual cost	N/A	$79.0 million	$56.6 million

7.0 SELECTION OF RECOMMENDED PLAN

The study team initially evaluated the effects of several barrier shoreline options against various sets of evaluation categories and criteria. The highest ranked options were modified and Alternatives 1 and 2 were developed using the most beneficial attributes of the options. The study team analyzed benefits at the 30- and 100-year periods. Costs were estimated for 30-years. This only compares 30-year benefits to 30-year costs to develop the recommended plan.

For this analysis, environmental benefits, socio-economic benefits, and costs receive equal importance in the evaluation of the alternatives. Where possible, the evaluation of the alternatives is site specific in order to maximize benefits and reduce costs. Ultimately, a recommended plan is based on the findings of the analysis.

7.1. Evaluation Criteria

The environmental benefits are strongly based on habitat benefits. This includes the effects of the alternatives in creating and preserving barrier island habitat, the reduction in loss of interior wetland habitat, and the benefits to the species that utilize these environments.

The economic benefits are based largely on reduction of flooding due to storm surge. Commercial and recreational fishery impacts, as well as pipeline reburial savings due to the reduction in land loss are included in the economic analysis.

The initial cost of each alternative includes design and construction administration, construction, vegetation, and contingencies. Each alternative has a 5-year maintenance cycle for repairs and damages to dunes, coastal structures, and beaches (where applicable). The maintenance costs are based on the assumption that historical erosion rates would continue into the future along non-stabilized shorelines. Armoring the gulf shoreline with revetments assumes that the shoreline will no longer migrate, but repairs to the dune and revetment would be necessary. In all areas, several engineering options were considered such as revetments, periodically renourishing the beaches and dunes, and using combinations of coastal structures and beach/dune renourishment. All options were considered and an initial and maintenance cost estimates were developed annualized over 30-years. A detailed discussion on these cost estimates is found in the Step K report (LDNR 1999).

7.2. Plan Description and Evaluation

The barrier shoreline alternatives were compared to the without project (no-action) alternative. The evaluation consisted of analyzing the effects of the alternatives using the described criteria.

Based on the environmental impacts, the no-action alternative is not a recommended plan. No-action assumes continued loss of the barrier shoreline and interior wetlands. The continued deterioration of wetlands in the study area would destroy wetland habitats, and negatively impact potential production of existing species. Several threatened and endangered species of birds use the barrier shoreline for nesting and foraging habitat. Increases in open water habitat could potentially be beneficial to oysters and some types of fish. However, the negative impacts to other environmental resources associated with the loss of interior wetlands and the barrier shoreline outweigh those marginal gains. Therefore, no-action is considered environmentally unacceptable throughout the study area. No-action is projected to increase the susceptibility of storm surge flooding throughout the study area.

7.2.1. Isles Dernieres and Timbalier Islands

The recommended plan along the Isles Dernieres and Timbalier Islands is Alternative 1. The two island chains provide the outermost protection to the western half of the study area and the benefits provided by both would be felt jointly throughout this region. The continuous barrier configuration along the Isles Dernieres and between West Belle Pass and East Timbalier Island eliminates any shoreline discontinuities (sediment sinks) and allows more sediment to remain in the littoral system.

The Alternative 1 footprint has the widest cross-section which would benefit in reducing overwash and channelization on the island. The recommended dune height is +7.0 feet (NGVD) based on the most cost effective storm design (LDNR 1998k). A typical cross-section of the barrier shoreline along the Isles Dernieres and Timbalier Islands is shown in Figure 7-1. A total of 3,150 acres (4.9 mi^2) of saline marsh would be created on the Isles Dernieres with an additional 705 acres of vegetated dune and beach habitat. For the Timbalier Islands, 3,493 acres (5.5 mi^2) of saline marsh and 782 acres of vegetated dune and beach habitat would be created. Wave absorbers placed along Caillou Bay, Lake Pelto, and Terrebonne/Timbalier Bay help dampen waves in the bays and provide hard bottom habitat.

The recommended engineering features and maintenance of the Isles Dernieres and Timbalier Islands are slightly different. Along the Isles Dernieres, a combination of sand and structures is recommended (LDNR 1998k). The vegetated dune and marsh templates will be built and the beach fill will be placed and renourished using a 5-year maintenance period. No advanced fill (additional beach fill placed to offset erosion expected to occur between maintenance periods) will be included. Wine Island is the exception, where a rock revetment will be constructed around the island to offset erosion and lack of updrift sediment. Segmented offshore breakwaters are recommended at the New Cut and Whiskey Pass closures. The breakwaters limit wave energy acting on the newly constructed land in what was previously a tidal inlet. A modified sand only option (LDNR 1998k) is recommended for Timbalier and East Timbalier Islands. The dunes, saline marsh, and beach would be constructed and maintained using sediment from tidal shoals. At East Timbalier Island, a beach fill is recommended between the existing rock dike and the island similar to a perched beach. A terminal groin would placed on the western end of Timbalier Island to reduce lateral migration and maintenance costs. A 5-year maintenance period will be used to renourish the beaches, and repair dunes, groins, and offshore breakwaters. Figures 7-2 and 7-3 show the barrier shoreline configuration of Alternative 1, while Figures 7-4 and 7-5 show the location of the wave absorbers.

In evaluating the environmental benefits, the Alternative 1 footprints along the Isles Dernieres and Timbalier Islands are considerably larger than for Alternative 2 when compared to the no action alternative. Alternative 1 creates a combined total of 6,643 acres of saline marsh on

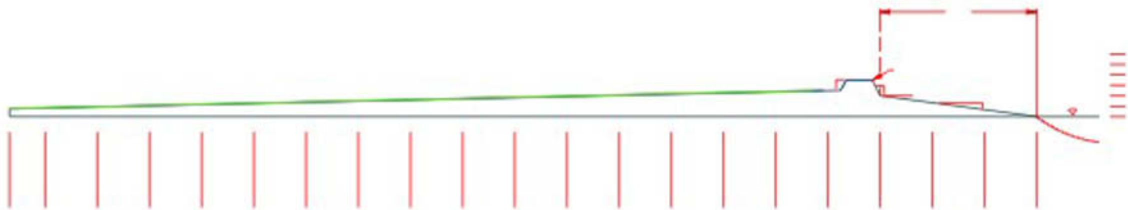


Figure 7-1

Figure 7-2

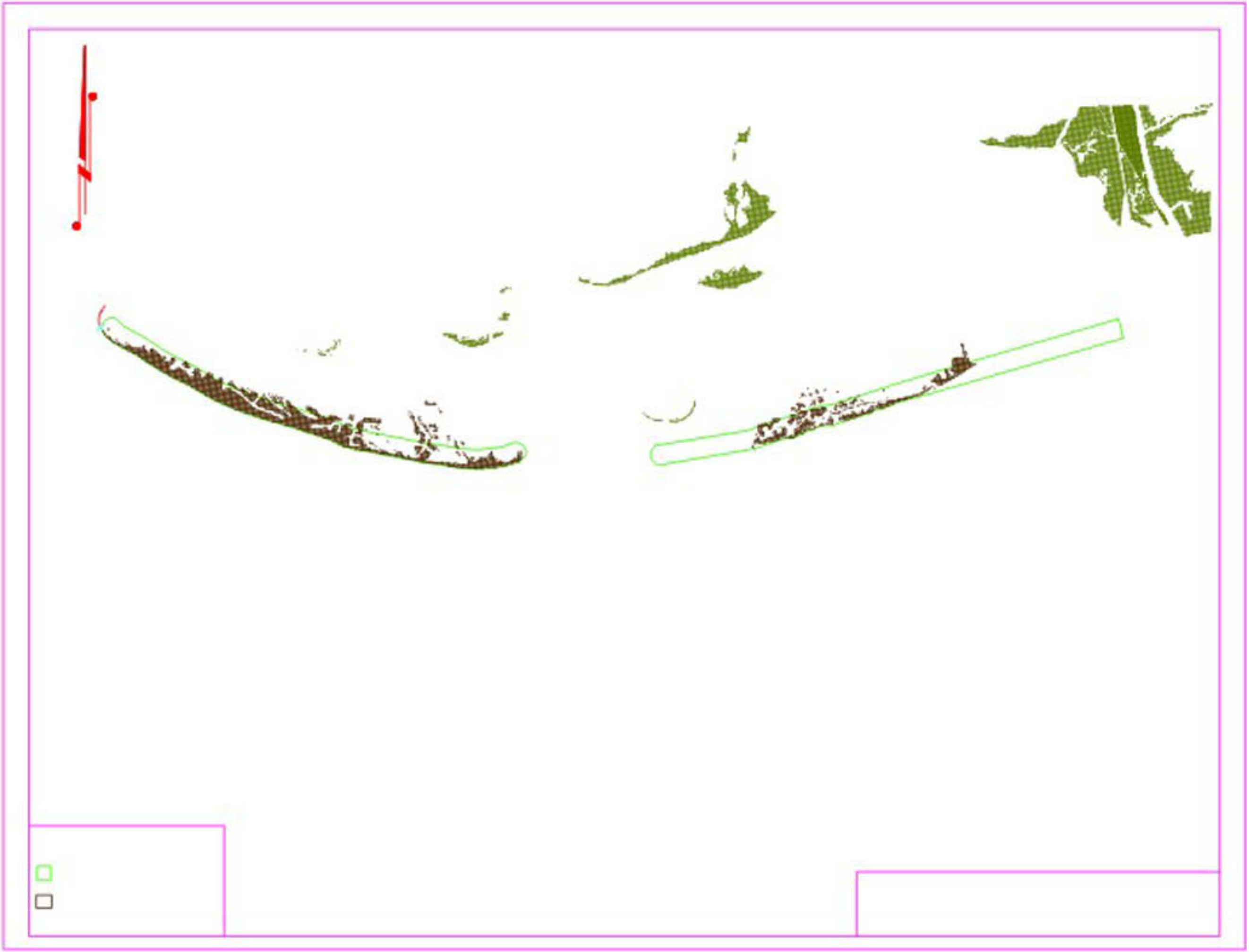


Figure 7-3

Figure 7-4

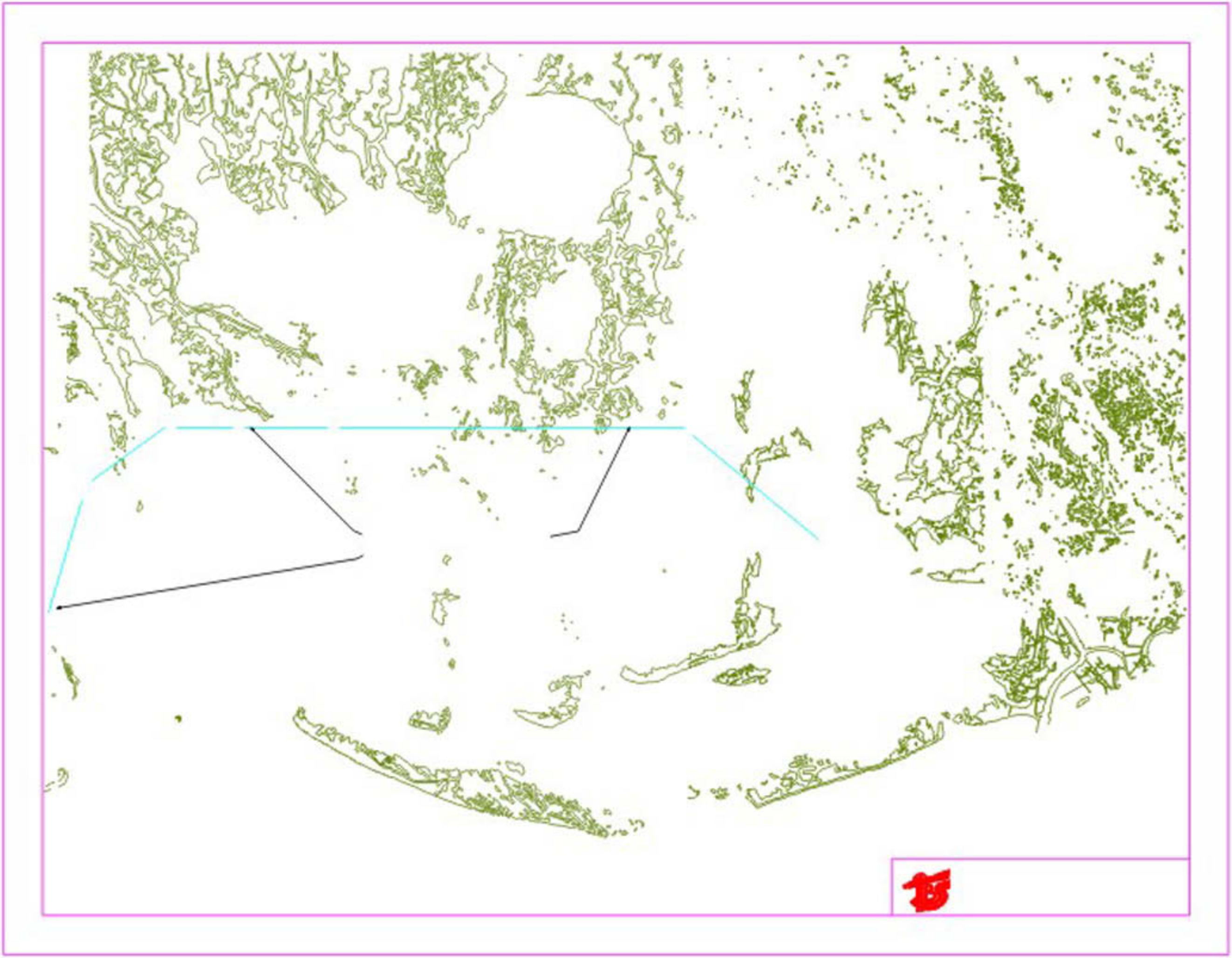


Figure 7-5

the Isles Dernieres and Timbalier Islands compared to 3,698 acres with Alternative 2. Alternative 2 would not include wave absorbers in the bays to dampen waves and reduce marsh erosion. Also, in the western section of the study area (Terrebonne Basin), Alternative 1 is projected to preserve 7,987 acres in 30-years compared to 657 acres for Alternative 2. The construction of the Recommended Plan will provide habitat for many species of birds, including the Piping Plover, Brown Pelican, and the Least Tern.

Implementation of Alternative 1 in the Isles Dernieres and Timbalier Islands sub-areas will have the greatest storm surge impact in Lafourche and Terrebonne Parishes. In these parishes only, the average reduction in storm surge damage due to Alternative 1 is predicted to be $5.5 million in 30-years and $0.5 million for Alternative 2.

7.2.2. Caminada-Moreau Headland

The recommended plan for the Caminada-Moreau Headland is to construct the +8.7 foot high dune and using a modified sand only option using the cross-section shown in Figure 7-6 to maintain the shoreline along the alignment shown in Figure 7-7. The headland protects Port Fourchon, which services much of the offshore oil and gas industry in the Gulf of Mexico, and is therefore important both environmentally and economically. Over the last 300-years, the Caminada-Moreau Headland has supplied sand for barrier shoreline development and is part of the Bayou Lafourche seaward geologic framework for the eastern Terrebonne and western Barataria Basins (Penland *et al.* 1992). Since the Caminada-Moreau Headland is the primary sediment source for other shorelines, maintaining this headland is recommended using beach fill. The sediment along the Caminada-Moreau Headland moves laterally along the shoreline east to Caminada Pass and Grand Isle or west accumulating against the West Belle Pass jetties. Using rocks to armor the shoreline may create downdrift sediment deficits and potentially create more negative impacts.

The Caminada-Moreau Headland has the highest erosion rate in the study area which results in a large estimated maintenance cost of $48 million annually for 30-years. To reduce the costs, the recommended maintenance plan is to remove the advance fill and establish the periodic maintenance to only renourish half the shoreline lost between maintenance cycles.

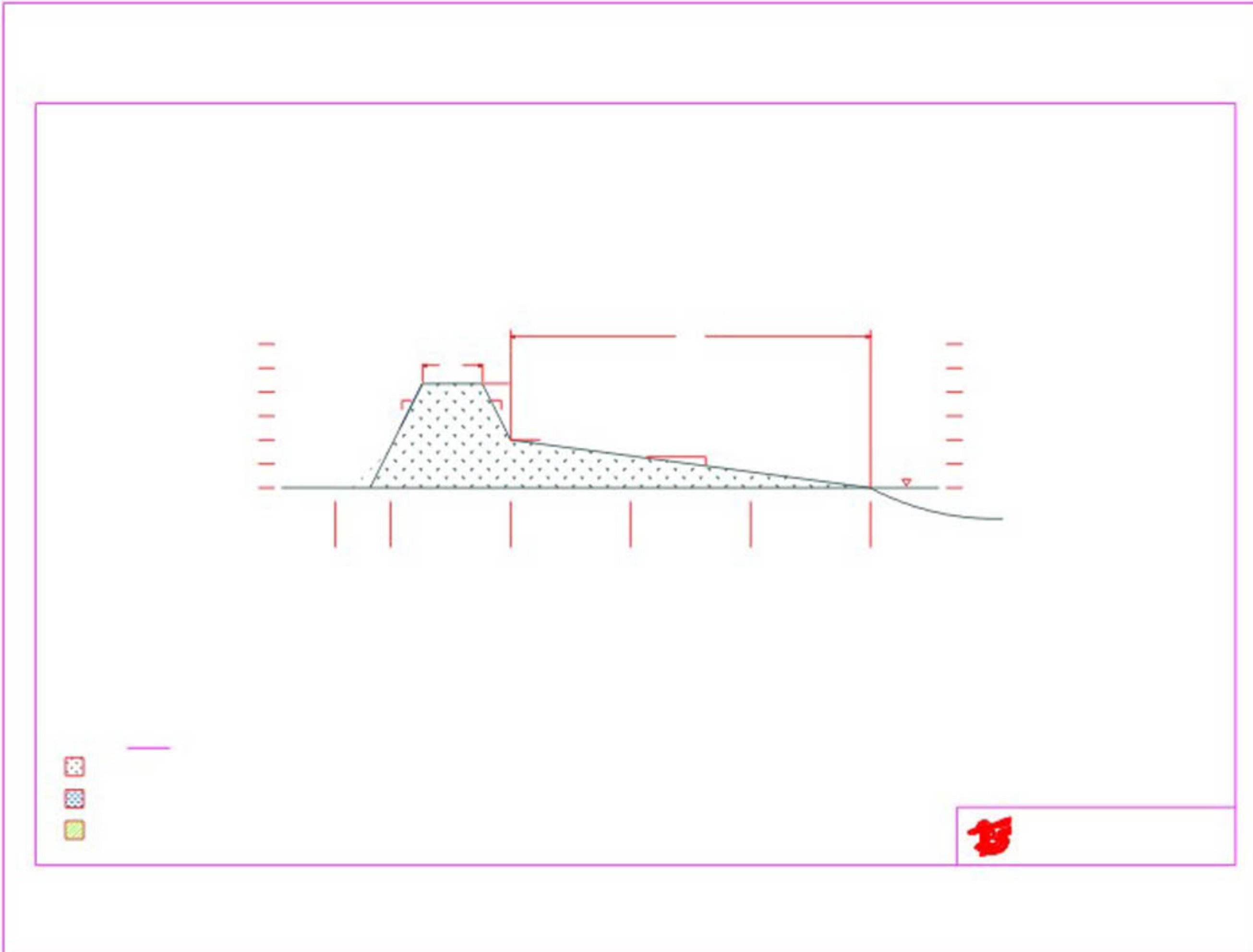


Figure 7-6

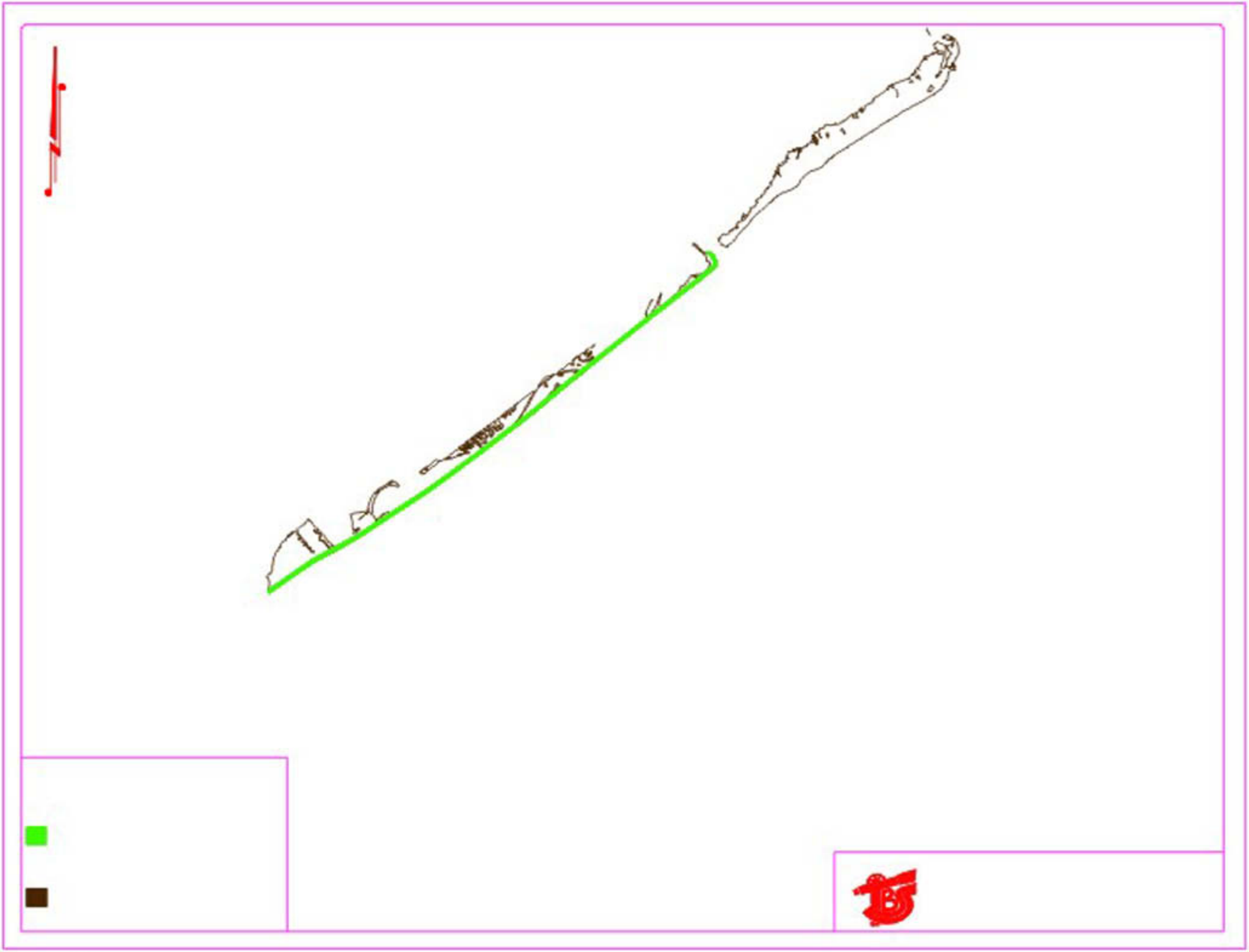


Figure 7-7

Therefore, the recommended plan is to offset (reduce by half) the erosion rate of the Caminada-Moreau Headland by using beach fill.

The historical shoreline erosion rate for the Caminada-Moreau Headland is 43.6 ft/yr. By reducing the rate of loss by 50% and projecting this into the future for 30-years over the length of the shoreline, an estimated 920 acres of beach, dune, and saline marsh habitat would be preserved under the recommended plan. The plan would also provide flood protection to Lafourche and Jefferson Parishes by providing 18 miles of barrier shoreline protection from Little Pass to Caminada Pass. The recommended plan for the Caminada-Moreau Headland is the highest priority for barrier shoreline restoration based on its systemic impacts in the study area and its direct impacts to environmental and economic resources near the shoreline.

7.2.3. Grand Isle

The recommended plan along Grand Isle is to continue the U.S. Army Corps of Engineer's flood protection program on the island, consisting of dune and berm protection along the gulf shoreline. The island is inhabited and has previously received federal funding to build dunes higher to protect the people and property on Grand Isle. The program is important in protecting recreational and commercial fishing interests as well as industrial facilities established on the island. In addition, Grand Isle is not predicted to be lost in 30-years. For these reasons, no additional large-scale restoration project is recommended in this study.

7.2.4. Plaquemines Shoreline

After evaluating all engineering options and benefits, the recommended plan for the Plaquemines Shoreline is to construct Alternative 2 using a rock revetment along the gulf shoreline. The no-action alternative is not acceptable due storm surge increases and the amount of open bay and marsh that would be left exposed as the barrier shoreline deteriorates in 30-years in addition to the loss of existing island habitat.

The wave model results only predict minor changes in wave climate for the bays behind much of the Plaquemines Shoreline; therefore, only 123 acres of saline marsh preserved was credited to Alternative 2 compared to 937 acres with Alternative 1. In both cases, the land preserved was in Barataria Bay. Alternative 2 would create 2,757 acres of saline marsh and 720 acres of dune habitat. Alternative 1 would create 5,693 acres of saline marsh and 759 acres of dune habitat. Various species of birds could use the habitat created and maintained including the Piping Plover, Brown Pelican, and the Least Tern. In addition, approximately 30-miles of the Plaquemines shoreline would be armored using the revetment option. Although this is not considered beach habitat, the revetment could provide hard-bottom habitat.

Plaquemines and Jefferson Parishes are the parishes most directly impacted by the Plaquemines Shoreline recommended plan. Compared to no-action, the combined average reduction in storm surge damage in these parishes due to Alternative 2 is $14.5 million. Alternative 1 reduces damage by $23.0 in 30-years.

The Plaquemines Shoreline has experienced high rates of erosion over its expansive shoreline, therefore, the cost to maintain these barrier islands would be expensive. The average annual cost to maintain Alternative 2 is $22.7 million using sand only. Combined with the initial project cost, the total annual cost is $32 million for the sand only option. By comparison, the revetment option has a total annual cost of $26.8 million. In addition, the sand needed to renourish the Plaquemines Shoreline during maintenance periods is limited in the area. At this time, as discussed in the Step K report, no economically justifiable method for delivering sand from the Mississippi River to this 30-mile shoreline has been developed (LDNR 1998k). The primary sources of sediment are tidal shoals and distributary channels. The high construction cost and concerns about sediment availability for Alternative 1 led to the recommendation of Alternative 2 and the use of the revetment option.

The available sediment from the shoals and distributary channels may be more suitable for marsh creation and dune construction than for beach fill. The recommendation is to build a revetment along the gulf shoreline to protect the dune and marsh created. Alternative 2 would leave existing inlets open while restoring the islands to a wider section with a +8.7 foot high vegetated dune and marsh platform (Figures 7-8 and 7-9). Periodic maintenance is included to repair the revetment from minor storm damages.

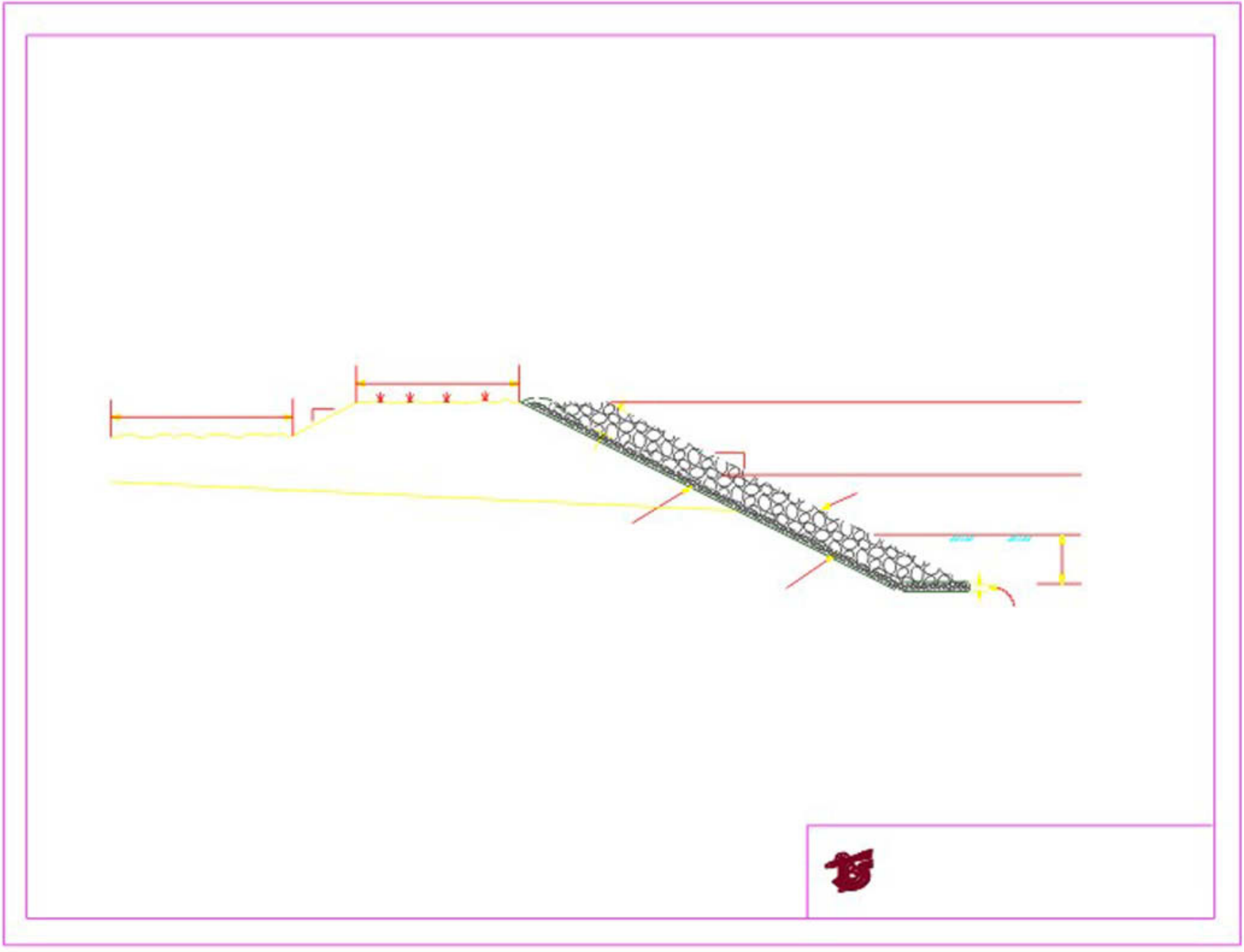


Figure 7-8

Figure 7-9

7.3. Project Costs

The total present value project cost is estimated to be $951 million. This includes costs for initial construction, maintenance of beaches, dune repairs, structure repairs, shaping and planting on the islands, engineering, planning, design, construction management, and a 25% contingency. The costs assume a maintenance cycle every 5-years after initial construction is completed and maintenance through 30-years. The present value costs are summarized in Table 7-1 and are itemized in Table 7-2.

Table 7.1. Summary of Recommended Plan Present Value Costs (30-years)

Item	Cost
Construction cost	$ 396,680,416
Vegetation	$ 7,552,655
Engineering and planning	$ 80,846,614
Maintenance	$ 365,058,667
Contingency	$ 101,058,268
Total	**$ 951,196,620**

7.4. Construction Sequencing

A summary of the benefits and cost of the Recommended Plan is found in Table 7.3. The benefits in Table 7.3 compare the Recommended Plan with the no-action conditions in 30-years.

The study team considers the Caminada-Moreau Headland to be the most important area for shoreline restoration. This shoreline is the primary sand source for much of the barrier shoreline in the study area and is eroding at a larger rate than any other beach in the Phase 1 Study Area. Placement of sand along the Caminada-Moreau Headland will first promote littoral transport of sand throughout the system while protecting the infrastructure at the Port of Fourchon.

Table 7-2. Itemized Costs for Recommended Plan

Region	Item	Subtotal	Contingency	Total Cost
Isles Dernieres				
	Construction costs:			
	Mobilization/Demobilization	2,000,000	500,000	2,500,000
	Terminal groin	144,584	36,146	180,730
	Breakwaters	4,800,560	1,200,140	6,000,700
	Revetments	3,401,352	850,338	4,251,690
	Hydraulic fill	54,702,488	13,675,622	68,378,110
	Containment dikes	8,673,610	2,168,403	10,842,013
	Wave absorbers	15,789,490	3,947,373	19,736,863
	Vegetation	860,205	215,051	1,075,256
	Engineering and planning	18,074,458		18,074,458
	Maintenance	20,038,209		20,038,209
			Subtotal	151,078,028
Timbalier Islands				
	Construction costs:			
	Mobilization/Demobilization	2,000,000	500,000	2,500,000
	Terminal groin	144,584	36,146	180,730
	Hydraulic fill	63,456,602	15,864,151	79,320,753
	Containment dikes	9,616,142	2,404,036	12,020,178
	Wave absorbers	23,734,520	5,933,630	29,668,150
	Vegetation	953,924	238,481	1,192,405
	Engineering and planning	19,981,154		19,981,154
	Maintenance	60,556,767		60,556,767
			Subtotal	205,420,136
Caminada-Moreau Headland				
	Construction costs:			
	Mobilization/Demobilization	1,000,000	250,000	1,250,000
	Hydraulic fill	4,769,833	1,192,458	5,962,291
	Containment dikes	5,996,034	1,499,009	7,495,043
	Vegetation	1,998,920	499,730	2,498,650
	Engineering and planning	2,752,957		2,752,957
	Maintenance	272,804,440		272,804,440
			Subtotal	292,763,381
Plaquemines Shoreline				
	Construction costs:			
	Mobilization/Demobilization	1,000,000	250,000	1,250,000
	Revetment	49,130,431	12,282,608	61,413,039
	Hydraulic fill	130,973,288	32,743,322	163,716,610
	Containment dikes	15,346,898	3,836,725	19,183,623
	Vegetation	3,739,606	934,902	4,674,508
	Engineering and planning	40,038,045		40,038,045
	Maintenance	11,659,251		11,659,251
			Subtotal	301,935,075

Table 7-3. Summary of Recommended Plan Compared to No-action (30-years)

Saline marsh preserved 30-years	8,110 acres
Saline marsh created and maintained	9,400 acres
Dune and nearshore habitat created and maintained[1]	3,127 acres
Threatened and endangered species	Nesting and foraging habitat created for 3 bird species; Foraging habitat created for 5 turtle species
Annualized non-storm savings	Less than $188,000
Storm damage savings in 30-years[2]	$14.8 million (Track 1) $25.3 million (Track 2)
Average annual project cost[3]	$84.5 million

[1]This acreage does not include the hard-bottom habitat created by the wave absorbers, revetments, groins, or breakwaters.

[2] Storm damage reduction is reported for Terrebonne, Lafourche, Jefferson, and Plaquemines Parishes only.

3Includes all engineering, construction, maintenance, vegetation, and contingency costs.

The construction sequence in other parts of the study area depends on the objectives. The Recommended Plan in the Isles Dernieres and Timbalier Island sub-areas will preserve existing saline marsh throughout the bays and reduce flood damage in the Terrebonne Basin. The Recommended Plan would create a saline marsh, dune, and beach habitat along the seaward barrier of the system. Hard bottom habitat would be provided by those coastal structures recommended along the barrier shoreline, as well as the wave absorbers at the bay shorelines. The wave absorbers should be constructed concurrently with the islands to maximize the wave dampening benefits.

The Recommended Plan along the Plaquemines Shoreline would create a saline marsh and dune habitat at the islands. A rubble mound revetment would protect the gulf shoreline provide hard bottom habitat. In addition to habitat created, the Plaquemines Shoreline offers significant flood protection benefits.

If the objective is to preserve and create as much marsh as possible, the Isles Dernieres and Timbalier Island areas should be a priority. If the objective is to provide storm surge protection, the Plaquemines area should be a priority.

7.5. Project Implementation

Implementation of the preferred plan requires that several actions take place, including: 1) identification of a local sponsor, 2) identification of potential funding options, and 3) planning, engineering, and design.

7.5.1. Identification of Local Sponsor

The identification of a local sponsor will have a direct bearing on which funding source is most appropriate. Although the two are discussed in separate sections, they are interdependent.

The study team prepared this report for the Louisiana Department of Natural Resources (LDNR). The state, acting through LDNR, must decide if it is in the best interest of the state to pursue some or all of the recommendations contained herein. If it is assumed that the state will implement some or all of these recommendations, a sponsoring agency is necessary.

The State of Louisiana maintains a Coastal Wetlands Trust Fund that was created to fund projects similar to those recommended in this report. The LDNR manages the fund in coordination with the Governor's Office of Coastal Activities. The LDNR, through the Coastal Restoration Division (CRD), is the logical agency to sponsor any shoreline restoration projects. If federal funding is acquired, LDNR/CRD could act as the local sponsor, similar to the present arrangement under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). Several shoreline restoration projects have been funded in this manner.

If LDNR is unwilling or unable to act as the sponsor for any or all of the recommendations contained herein, other state agencies (Louisiana Department of Transportation and Development, Louisiana Department of Wildlife and Fisheries) could assume that role. These agencies could sponsor a project funded through the state capital outlay process or the trust fund mentioned above.

Finally, several of the coastal parishes and state sub-districts have funded restoration projects in the past. A local governing body could act as a local sponsor for features within its respective parish boundary.

7.5.2. Potential Funding Sources

There are several funding sources available. As mentioned above, the potential funding source and local sponsor are directly related. The choice of local sponsor will have a direct bearing on the appropriate funding source, and vice-versa.

Corps of Engineers Programs

There are several Corps of Engineers programs which could be utilized to fund the study recommendations.

- Sect. 204 – Beneficial Use of Dredge Material – This provision allows the Secretary of the Army to carry out ecosystem restoration efforts in connection with authorized navigation projects. The ecosystem restoration projects are funded as navigation construction or operation and maintenance costs up to the level of the base plan. For costs above the base plan, non-Federal interests must contribute in 25% of the costs. This program could be used to construct parts of the recommended plan in close proximity to the federally maintained channels in the study area.

- Sect. 1135 - Restoration of Environmental Quality – This provision provides funding for projects which are meant to compensate for the detrimental environmental impacts of water resource projects. The cost share is 75% Federal to 25% non-Federal. Up to $5,000,000 (Federal Funds) may be spent on any measure or modification.

- Sect 206 – Ecosystem Restoration – This provision is similar to the Sect. 1135 program, but no connection to a Corps project is necessary. The cost share is 65% Federal/ 35% non-Federal, and there is a maximum Federal contribution of $5,000,000 per project. This program could be used to fund all or part of the recommendations contained herein.

Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) (CWPPRA, PL 101-646)

This act provides approximately $40,000,000 per year for ecosystem restoration (particularly coastal wetlands) projects mainly in South Louisiana. The cost share is 85% Federal/ 15% non-Federal.

Water Resources Development Act Funding

A specific item, separate and apart from the programs listed above, could be inserted in the Water Resources Development Act for any or all of the recommendations contained herein. A local sponsor and match is not always necessary, but would greatly enhance the chances for authorization and funding.

Louisiana Coastal Wetlands Trust Fund

The State of Louisiana through the Louisiana Department of Natural Resources and the Governor's Office of Coastal Activities manages this fund. State revenues related to oil and gas activities support the Fund. Monies in the fund are dedicated to coastal wetland restoration and have been used to fund projects similar to the recommendations contained herein.

State Capital Outlay

A specific item could be inserted into the state capital outlay bill at any time. Projects similar to those proposed in this report have been funded through the state capital outlay process in the past. As with the federal Water Resources Development Act process, a local match would probably enhance the chances of authorization and funding.

Mitigation Funds

State and federal regulatory bodies require mitigation for impacts to coastal resources and/or wetlands. This mitigation is preferred in or near the same location as the impacts. Impacts to areas in the vicinity of the shoreline could be mitigated by implementing some or all of the recommendations contained herein.

Planning, Engineering and Design

Assuming that a sponsor and a funding source are selected, the next step is detailed design of the project. The recommended plan contains many separate features that may be implemented independent of the others. Thus, the detailed design steps required could be different depending on the feature being implemented. Steps that are common to all include:

1) Surveying
2) Right of Way Investigation/Acquisition
3) Permitting
4) Environmental Assessment
5) Borrow Site Investigation
6) Preliminary/Final Engineering Design
7) Construction Administration

8.0. DATA NEEDS

The reports prepared as part of the Barrier Shoreline Feasibility Study were based to a great extent on existing information. The existing data was used to predict future conditions with- and without-projects and provided the study team with quantitative tools to develop the recommended plan. Throughout the study, the team identified areas where data or predictive tools were lacking or unavailable. Realizing that all study efforts are limited by various constraints, certain areas where data gaps exist include:

- Updated topography and bathymetry – Much of the topographical and bathymetric data for the islands, marsh, and water-bottoms are from 1990 and need to be updated.
- Water levels, currents, and sediment transport in the marshes – Long-term water level and current data is limited throughout much of the study area and would provide data for model calibration and verification. Data on sediment transport in the marshes is also limited, which could provide a better understanding of the processes that impact marsh viability.
- Detailed borrow source information – Data on sediment grain size and distribution is limited throughout the study area. Extensive geotechnical sampling has been limited to areas where projects have been designed and at Ship Shoal.
- Nearshore wave and sediment transport statistics – There are no nearshore wave gauges in the Phase 1 Study Area. Wave information is limited to hindcast data and offshore buoys. There is also little data available on sediment transport along the nearshore that is updated and useful for design.
- Infrastructure damages classified by “cause” – Although there is some infrastructure damage data available, it is not classified by cause (i.e., wind, flooding, etc.).
- Road and bridge damage statistics – Limited data is available on the damage costs to roads and bridges due to flooding.
- Oil and gas infrastructure damages – There is little specific data on damages to such facilities due to storms, flooding, or wind.
- Wave and marsh shoreline interaction processes – More study as to the interaction between waves and the marsh shoreline is necessary.

- Process-based land loss prediction model – The land loss prediction used in this study is based on projecting past land loss rates into the future, not on the processes of land loss.
- Monitoring data for existing barrier shoreline restoration projects – A number of reports have documented the processes of some sections the barrier islands. However, little information is available on the effects of restoration projects (Isles Dernieres Restoration, Raccoon Island Breakwaters, Grande Terre Beneficial Use Project, etc.).

9.0. REFERENCES

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