THE RESTORATION PLAN

The CWPPRA Restoration Plan is based on a combined knowledge of the natural processes of the delta and chenier environments, the factors responsible for wetlands loss, and the techniques available for restoration, as summarized in previous sections of this report. Based on this knowledge, the CWPPRA Task Force formulated its planning goals and strategies and applied them to each of nine separable hydrologic basins along the Louisiana coast. The resulting basin plans not only provide a fit between established project techniques and the problems and resources of specific areas, but they also develop new management concepts--some using unprecedented regional solutions, others based on potential demonstration of innovative technologies. Because many new concepts are proposed, the plan adopts a phased approach in which projects that address specific problems continue to be built in the short term, while at the same time major steps are taken toward implementing the larger scale, higher cost restoration efforts which represent the long-term cornerstone of the plan.

PLANNING GOALS AND STRATEGIES

Formulation of the comprehensive wetlands restoration plan for coastal Louisiana was guided by two basic goals established by the Task Force early in the planning process. Those goals are:

- to sustain the ecological value and economic productivity of the Louisiana coastal wetlands; and
- to accomplish this by maintaining and improving critical wetland functions.

The primary strategy established by the Task Force for meeting those goals is to maintain and restore natural processes where feasible. The objective of that strategy is to work with, not against, natural processes to promote wetland sustainability. Implementation of this strategy will require large-scale projects, especially freshwater and sediment diversions, that produce regional wetland benefits; it will also require smaller projects aimed at hydrologic and vegetative restoration. A supporting strategy will also be implemented, especially in the short term. That strategy is to abate wetland losses in situations of critical need or significant opportunity, i.e., "keep what we have," and to offset or reverse the remaining losses by wetland creation or shoreline protection measures that would result in wetland accretion.

These goals and strategies recognize that numerous constraints make it infeasible to restore the Louisiana coast to the natural condition which existed many decades ago, and that the Louisiana coast is an extremely dynamic system. Several additional principles have guided the restoration planning process thus far, and will assume more importance as implementation progresses. Those principles are:

1. Restoration projects must benefit the communities of Louisiana's coastal zone and not reduce their long-term economic viability. Those projects must be designed to maintain at least the current level of flood protection and transportation infrastructure. Projects that will unavoidably result in displacement of facilities and harvest areas for living resources must, to the

extent practicable, be implemented gradually and include measures to minimize or offset unavoidable short-term economic dislocations.

2. Restoration projects must seek to maintain and enhance the long-term biological productivity and biodiversity of Louisiana's coastal systems, which provide the primary impetus for restoration. This principle can be achieved by use of natural processes, or by design of project-specific measures (such as provisions for estuarine access through water-control structures).

DEVELOPMENT OF PLANS FOR INDIVIDUAL HYDROLOGIC BASINS

The formulation of the comprehensive Restoration Plan utilized a basin-by-basin approach. That approach was needed to address the unique set of problems and restoration opportunities specific to each of the nine hydrologic basins in coastal Louisiana (Plate 1 depicts the nine basins).

The basin plans formulated during the restoration planning process are visions for building projects that establish hydrologic conditions to benefit wetlands on a regional scale. Each of the basin plans (which are summarized in the sections to follow) is responsive to the overall restoration goals outlined above, within the limitations imposed by factors unique to each basin. The typical plan identifies key strategies for protecting, creating, restoring, and enhancing wetlands in that basin. Those strategies lay the foundation on which wetland protection and restoration throughout the basin will be achieved.

INTEGRATION OF BASIN PLANS

REGIONAL CONSIDERATIONS

It was recognized early in the planning process that large-scale, regional restoration projects that potentially affect multiple coastal basins and the management of the Mississippi and Atchafalaya rivers are needed to counter the sediment deficit and achieve the goals of the plan. It also became apparent that the causes of wetland loss in the Deltaic Plain are different from those in the Chenier Plain. Perhaps even more importantly, the types of restoration opportunities available in those two regions are significantly different. Even within the Deltaic Plain, restoration opportunities within the active deltas of the Mississippi and Atchafalaya rivers are different from many of those in the abandoned delta basins.

As shown in Figure 3 of the Executive Summary, the comprehensive restoration strategy advocates a diversity of approaches tailored to problems and opportunities across the Louisiana coastal region. Where possible, those approaches make use of beneficial natural processes to achieve large-scale wetland creation, and to abate losses of existing wetlands by regional restoration of hydrology.

In the Deltaic Plain, all basin plans recommend strategies to make better use of the critically important fresh water and sediments transported by the Mississippi and Atchafalaya rivers. Within that region, improved sediment management is recommended to enhance wetland creation in the active deltas of those two major rivers. Large-scale restoration of hydrology to abate wetland loss is recommended in the Pontchartrain, Breton Sound, Barataria, and Terrebonne basins of that region; barrier island restoration is a major component of the hydrologic restoration strategy in the Barataria and Terrebonne basins.

Restoration opportunities in the Chenier Plain are primarily shoreline protection, hydrologic and salinity management, marsh creation with material removed during maintenance dredging, and some limited freshwater diversion. With the exception of possibly modifying the design or operation of the structures that control water levels in the Mermentau Basin, the recommended restoration strategies primarily address more local, symptomatic problems arising from the underlying problems of subsidence, saltwater intrusion, hydrologic modification, and scour erosion of fragile marsh soils. A possible sediment source for the Mermentau Basin is the coastal mud stream; however, for most of this region a long-term sediment source is not available. Therefore, the strategies for that region utilize protective projects and localized restoration projects.

Several smaller-scale approaches to abate wetland losses are common to both the Deltaic and Chenier Plain Regions. Examples of such approaches include marsh creation with dredged material, marsh management, and protection of natural shorelines and the banks of eroding navigation channels.

Creating marsh with dredged material removed during maintenance of navigation channels is recognized as an approach that has great potential for more widespread, coast-wide application. Increased use of this approach should be facilitated when a Louisiana Department of Natural Resources effort to develop a long-term management strategy for ten federally maintained navigation channels is completed in June 1994. That strategy will supplement prior interagency disposal planning efforts spearheaded by the USACE.

Table 4 shows the types of solutions utilized in the various basins. In short, the plan proposes the building of new wetlands wherever sediment is available, and the restoration, protection, and enhancement of existing wetlands wherever such actions are needed and practical.

The topic of interbasin restoration issues was addressed during the restoration planning process. The Task Force determined that restoration measures that potentially affected more than one basin primarily involved allocation of the freshwater and sediment resources of the Mississippi and Atchafalaya rivers among basins to achieve optimum wetland benefits. Such allocation will require detailed feasibility analysis to determine the amount of fresh water and sediment available for diversion, and to compare the merits and constraints associated with each potential diversion option. Rational interbasin decisions regarding large-scale application of these resources can be made once this information is developed.

PHASED ELEMENTS OF THE PLAN

The urgency of the wetland loss problem in coastal Louisiana mandates that restoration work move forward along many tracks at once. Recommended smaller-scale projects represent a critical first step in a *phased process* for implementing the solutions presented in this plan. Installation of high priority, smaller-scale projects (Table 4) will address the short-term strategy of abating losses in areas of critical need or opportunity, and offsetting losses via smaller-scale wetland creation measures

Table 4
Distribution of Solutions

Major Strategies	Active Delta		Abandoned Delta					Chenier Plain	
	MR	AT	PO	BS	BA	TE	TV	ME	CS
Use existing sediment	ST	ST							
Move sediment to more effective location	LT	LT							
Restore sediment			LT	LT	LT	LT	LT	LT	
Restore and manage fresh water			ST LT	ST	ST LT	ST LT	ST LT	ST	
Restore or construct barrier islands			LT	LT	ST	ST			
Preserve or build land bridges or natural ridges			ST	LT	LT	ST			
Reduce salinity and tidal scour with structures			ST		ST	ST LT		ST	ST
Reduce flooding in wetlands			ST			LT		ST	
Protect shorelines			ST	ST	ST	ST	ST	ST	ST
Small-scale, site-specific measures	ST	ST	ST	ST	ST	ST	ST	ST	ST

ST=short-term strategy
LT=long-term strategy

PO=Pontchartrain
BS=Breton Sound
MR=Mississippi River Delta
BA=Barataria
TE=Terrebonne

AT=Atchafalaya
TV=Teche/Vermilion
ME=Mermentau
CS=Calcasieu/Sabine

(e.g., small-scale sediment diversions and beneficial use of dredged material). The strategy for abatement of losses of existing wetlands places a high priority on building projects that will produce regional benefits, especially those that will restore natural hydrologic conditions. These initial phase projects will be implemented in a manner that does not preclude wetland benefits of planned large-scale projects, such as major freshwater and sediment diversions. As with the smaller-scale projects, implementation of small-scale demonstration projects to apply new technologies or materials can proceed now without the need for detailed feasibility studies.

As can be seen in Table 4, there are numerous strategies in the restoration plan which are intended to be executed on a long-term basis. The major freshwater and sediment diversion projects recommended for the Deltaic Plain would provide long-term solutions to the underlying problems of land loss, subsidence, the enlarging tidal prism, and erosion of organic soils. Development of a sediment budget for the lower Mississippi River will provide critically needed information for feasibility studies of large-scale sediment diversions. An important long-term measure, of which a feasibility study is called for in Section 307(b) of the CWPPRA, is the potential increase of Mississippi River flows and sediment down the Atchafalaya River for land building and wetlands nourishment. The enhanced management of sediments in the Atchafalaya Delta to optimize growth of deltaic wetlands is also a long-term measure. The extensive restoration of coastal barrier islands and measures to address the encroachment of marine processes, such as installing a salinity barrier on the Houma Navigation Canal, are also major long-term elements of the plan.

Detailed feasibility studies will be required to evaluate various diversion options. There is a limit to the number of diversions that can be constructed without adversely affecting navigation channel maintenance and the freshwater supplies of New Orleans and other communities. Similar evaluations will be needed for other large-scale restoration proposals. The required studies will address a wide range of economic, social, engineering, and environmental factors. Once these studies are completed the detailed design and construction of these projects can be phased into the restoration effort.

The State of Louisiana has made the following recommendations to the chairman of the Task Force concerning its priorities for feasibility studies:

- Increasing the share of Mississippi River-borne sediments carried down the Atchafalaya River;
- Re-establishment of the barrier island systems in the Barataria and Terrebonne basins;
- Modifications to major navigation channels to reduce or prevent saltwater intrusion into historically fresh or intermediate wetlands, and to reallocate flow and sediment for diversions into other areas; and
- Development of a comprehensive Mississippi River diversion plan, to include multiple diversions as appropriate.

The complete text of the recommendation is contained in Exhibit 8.

Feasibility studies of major restoration projects will be conducted concurrent with implementation of the short-term phase. In the meantime, smaller, critically needed projects recommended in the basin plans will be implemented to prolong the life of the most threatened wetlands until the larger projects are installed and more natural hydrologic and sedimentation regimes can be established.

RESTORATION PLAN BENEFITS

Current estimates are that another 868,000 acres of Louisiana's coastal wetlands will disappear by the year 2040 unless decisive action is taken. The areas where the most serious losses will occur are shown in Figure 2 of the Executive Summary. Clearly, the loss of such a vast amount of nationally important coastal wetlands would have devastating ecological and economic consequences. The restoration strategy proposed in this plan forcefully addresses that serious threat in a comprehensive manner. Implementation of the projects proposed in this plan would have major national benefits. Those benefits include:

- creating, restoring, and protecting nearly 203,000 acres of coastal wetlands over the next 20 years, thus reducing projected wetland losses by approximately 65 percent;
- helping to sustain a nationally important commercial fishery valued at $1 billion per year, supporting at least 50,000 jobs in Louisiana alone;

- helping to sustain the biodiversity and habitat values of a wetland complex that supports nationally important concentrations of wildlife; and

- helping to maintain the flood-control and storm-surge-reduction functions of the Louisiana coastal wetlands, which play an important role in protecting a capital investment of at least $100 billion in infrastructure (e.g., petrochemical production; ports and waterways; and commercial and residential development).

MONITORING AND EVALUATION OF THE PLAN

In accordance with the CWPPRA, the monitoring of projects that are constructed in pursuit of this restoration plan must provide:

1. an "evaluation of the effectiveness of each coastal wetlands restoration project in achieving long-term solutions to arresting coastal wetlands loss in Louisiana" [Sec. 303 (b)(4)(L)]; and

2. "a scientific evaluation of the effectiveness of the coastal wetlands restoration projects carried out under the plan in creating, restoring, protecting and enhancing coastal wetlands in Louisiana" [Sec. 303 (b)(7)].

Losses to Louisiana coastal wetlands have been the subject of extensive research by federal and state agencies, universities, and individual scientists and scholars. The CWPPRA Task Force has used information from that research to guide its planning and, in the process, became familiar with what is known--and not known--about the design and functioning of wetland restoration projects. Two facts became evident: (1) enough is known about the restoration of wetlands to enable the Task Force to select projects with a very high probability of achieving the anticipated short term benefits; and (2) much more needs to be learned about the optimum design of some projects, the efficacy of some large scale projects, and the appropriate mix of projects in various basins. In short, the appropriate immediate restorative measures can be clearly defined and applied, but, in the process, information needed to improve any subsequent efforts must be generated.

To achieve these requirements, the Monitoring Work Group of the Task Force developed a set of standardized monitoring procedures and established a monitoring program to implement the procedures. The monitoring plan is provided in Exhibit 5. It stimulates a continuous return of information at several levels by: (1) suggesting modifications to features or operations of already constructed CWPPRA projects to achieve better results, (2) guiding the selection of projects recommended for construction to achieve a project mix better suited for the conditions in each basin, and (3) stimulating research and studies on new technologies and approaches to wetlands restoration. This procedure provides the means to measure success on a project-by-project basis, and thus to ensure the overall success of the restoration plan.

KEY ISSUES

SOCIOECONOMIC

Although fisheries in south Louisiana will benefit overall, on a small-scale some parts of the fishery economy will be adversely impacted by certain projects such as freshwater and sediment diversions, marsh creation, hydrologic restoration, and marsh management.

Freshwater and sediment diversions from the Mississippi River will undoubtedly result in the forced relocation of some oyster resources, as oysters thrive only within a relatively narrow salinity range with an optimum near 15 ppt (parts per thousand) and cannot tolerate smothering from heavy sedimentation resulting from sediment diversion and wetland creation projects. Displacement of some oyster populations seaward is a possibility, rendering some existing oyster leases unworkable and forcing their relocation seaward. However, the overall effect of such restoration projects will be increased oyster fishery habitat. These impacts are expected to primarily affect the oyster industry in the Breton Sound, Barataria, and (possibly) Pontchartrain basins.

River diversions will impact other fisheries by reducing salinities in spawning and nursery grounds. These spawning and nursery grounds will not be lost, but will also be displaced seaward. The shrimp fishing industry will likely be affected the most by these changes, as travel farther south in the estuary to land the catch, or relocation of operational bases, will result. Similar effects will occur in the recreational spotted sea trout and red drum fisheries, as they relocate to areas where they existed historically prior to the saltwater intrusion and channelization in these estuaries.

Another socioeconomic consideration arises in the application of hydrologic restoration and marsh management projects. The nature of these projects sometimes demands that oilfield canals be plugged and structures installed in the marsh in an attempt to recreate the historic hydrologic regime interupted by these canals. The principal issues in these cases are the restriction of access for marine organisms and loss of navigable access for fishermen. Some restoration projects will reduce the present access by oil and gas and other commercial development; however, they will not totally eliminate access. Some restoration projects may result in continued access by longer routes. Development of hydrologic restoration and marsh management plans can provide fisheries and human access to the maximum extent possible without compromising the integrity of the plan. However, it is important to note that in a majority of cases, human and estuarine fisheries access to these marshes was not historically available.

REAL ESTATE AND LEGAL CONSIDERATIONS

Program Application on Private and Public Lands.

The implementation of an effective coastal wetlands restoration program in Louisiana requires working cooperatively with private landowners. Previous estimates indicate that approximately 80 percent of the state's coastal wetlands are privately owned, with the remaining areas being under ownership and management of State and Federal agencies. Historically, most of these areas have been devoted primarily to wildlife, fisheries, and recreational uses. However, mineral extraction and transportation are major interests throughout the coastal area, while beef production and grazing represent other examples of resource management consideration in selected coastal areas.

The authors of the enabling legislation, both Federal (P.L. 101-646) and State (R.S. 49:213.1-.22 and R.S. 49:214.1-.5), recognized the important need for working cooperatively with private landowners to address the needs for long-term wetland resource protection while minimizing infringements on private property interests and rights.

Historically, the expenditure of federal funding for resource conservation and protection programs has included numerous applications on private lands where public benefits and improvements have been identified. Such programs, like the CWPPRA, recognize the need to provide resource protection, conservation, and enhancement measures where they provide the most benefits. The collective application of such measures (a project) may be on private or public lands. Many of the project benefits may be off-site and contribute to public interests as previously discussed. However, the right of public access to private lands included in such projects is not a requirement for participation on behalf of cooperating private landowners.

Existing state law [R.S. 49:217.7(E)(2)] specifically addresses the issue of public access and provides for the protection of private property rights on private lands which may be affected as part of any wetland restoration project funded entirely or partially through the Louisiana Wetlands Conservation and Restoration Fund. Any decision to expend state funds for approved state restoration projects on private lands is based on the inherent general public benefits such projects provide (benefits to fish and wildlife, storm buffering, water quality, etc.). Since this fund is the major source of state matching funds for implementation of federally sponsored projects as well (CWPPRA), the entire restoration program effort must properly address private property interests and rights.

The Task Force recognized the need for addressing the sensitive issue of private property rights fairly early in the development of the initial priority project lists. This is evident in their decisions to require that project easements address only the rights necessary to meet the objective of long-term resource protection required in Section 303(e) of the act. The Secretary of the Army must ensure that designated lead federal agencies comply with this provision through appropriate land rights documentation prior to funding specific projects. The existing Task Force policy requires that easements provide sufficient language to provide protection for the projected life span of the specific project being implemented.

Public Domain Resources.

Natural, renewable resources in the public domain (i.e., fish and wildlife) are subject to the harvest regulations of the Louisiana Department of Wildlife and Fisheries (LDWF), the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, and to the private property laws of the state of Louisiana. This does not mean, however, that the public has the inherent right to harvest fish or wildlife on private property without permission, nor do private property owners have the right to harvest indiscriminately on their property in violation of applicable wildlife and fisheries regulations.

All methods for the harvest of public domain fish and wildlife resources must be in accordance with LDWF (Louisiana R.S. 56) and federal regulations. The entrapment of a public domain resource (i.e., coastal migratory fisheries) on private land by techniques other than those allowed by the LDWF under normal harvest methods is considered illegal. State law also prohibits the placement of nets within 500 feet of any water control structure to harvest fisheries resources (Louisiana R.S. 56 subsection 329).

Public and Private Ownership.

Historic provisions of the Louisiana Civil Code (Articles 450 and 452) specifically address the rights of ownership, use, and access of certain waters, water bottoms, lakes, rivers, and streams within the state. A recent opinion (No. 92-472) rendered by the State Attorney General's Office addresses issues relative to the rights of public use and private ownership concerning such water and adjacent land areas as they may be affected by state-approved wetland conservation projects. This opinion clearly states that Act 451 of 1990 [R.S. 41:213.7(E)(1-2)] "creates no rights in the public for use, access or any vested interest in privately owned lands or waters which are the subject of wetlands conservation projects, nor does the Act alter or modify historic Civil Code law concerning accretion, erosion, dereliction and subsidence." With this in mind, it is essential that the participating CWPPRA agencies be thoroughly familiar with the applicable state property laws and civil codes.

INTRODUCTION TO THE BASIN PLAN SUMMARIES

TERMINOLOGY

The following sections of this report summarize the restoration plans formulated for each of the nine basins in coastal Louisiana. Several key terms used in those plans are defined below.

Objectives are the endpoints toward which efforts to address wetlands problems are directed. *Key objectives* are those considered essential because they address the most fundamental causes of wetland losses or have regional impacts.

Strategies are general approaches to achieve objectives. *Key strategies* address key objectives.

Alternatives are mutually exclusive courses of action to achieve the same objectives.

Critical projects directly implement a basin's key objectives and strategy. Some critical projects are very large (e.g., major diversions); implementation of such projects will generally require lengthy planning, along with funding that is beyond the current capability of the CWPPRA. Some critical projects are part of an integrated subset of smaller projects that collectively achieve a regional impact.

Supporting projects are those that address more-localized wetland protection and restoration needs and opportunities.

The CWPPRA also provides for *demonstration projects* to apply new techniques or materials for wetland restoration, and to utilize established technologies in new ways or different environments. The basin plans contain small demonstration projects and may assign priority to those that pave the way for a critical project.

PROJECT NOMENCLATURE

The projects evaluated during the planning process were derived from several sources, the principal one being the scoping meetings held in October and November 1991. Hundreds of problems and proposals came out of those meetings

(Exhibit 4). To track projects through the screening and evaluation process, each project received an identification number proceeded by a two-letter code to identify its basin; these codes are shown in Table 5.

Table 5
Project Nomenclature

Symbol	Basin	Symbol	Basin
PO	Pontchartrain	AT	Atchafalaya
BS	Breton Sound	TV	Teche/Vermilion
MR	Mississippi River Delta	ME	Mermentau
BA	Barataria	CS	Calcasieu/Sabine
TE	Terrebonne		

Projects which are a part of the State's Coastal Wetlands Conservation and Restoration Plan use these two letters followed by a number. Projects derived from the scoping meetings are identified by a "P" ("public") preceding the two-letter code (e.g., PPO-52, PTV-18).

The plan formulation meetings held from February through May 1992 were an additional source of projects. Projects proposed during and after those meetings are identified with an "X" (e.g., XTE-41). Many of the "X" projects were formulated by the basin teams as they prepared the restoration plans for the various basins.

Some projects proposed during the planning process are not in a basin plan because they are inconsistent with CWPPRA objectives, e.g., a project that would not directly benefit wetlands.

The nine basin plan summaries which follow represent an attempt to condense into a manageable form the large volume of material contained in Appendices A through I. They provide a very brief outline of the process by which each basin plan was developed, using a broad brush to paint a picture of the restoration plan for each basin.

PONTCHARTRAIN BASIN: SUMMARY OF BASIN PLAN

STUDY AREA

The 1,700,000-acre Pontchartrain Basin is an abandoned delta generally bounded by the Pleistocene Terrace on the north and west, by Chandeleur Sound on the east, and by the Mississippi River and the disposal area of the Mississippi River Gulf Outlet (MRGO) on the south. Portions of nine parishes lie within the basin: Ascension, St. James, St. John the Baptist, St. Charles, Jefferson, Orleans, St. Bernard, St. Tammany, and Livingston. The basin is divided into six distinct areas: the upper, middle, lower, and Pearl basins, and the Lake Maurepas/Pontchartrain and Lake Pontchartrain/Borgne land bridges (Figure PO-1). Approximately 17 percent of the land in the basin is in public ownership.

EXISTING CONDITIONS AND PROBLEMS

The three large lakes, Maurepas, Pontchartrain, and Borgne cover 55 percent of the basin. Lakes Maurepas and Pontchartrain are separated by land bridges of cypress swamp and fresh/intermediate marsh. A brackish marsh land bridge separates Lake Pontchartrain from Lake Borgne.

The basin contains 483,390 acres of wetlands, consisting of nearly 38,500 acres of fresh marsh, 28,600 acres of intermediate marsh, 116,800 acres of brackish marsh, 83,900 acres of saline marsh, and 215,600 acres of cypress swamp. Since 1932, more than 66,000 acres of marsh have converted to water in the Pontchartrain Basin--over 22 percent of the marsh that existed in 1932. The primary causes of wetland loss in the basin are the interrelated effects of human activities and the estuarine processes that began to predominate many hundreds of years ago, as the delta was abandoned.

The Mississippi River levees significantly limit the input of fresh water, sediment, and nutrients into the basin. This reduction in riverine input plays a part in the major critical problem in the Pontchartrain Basin--increased salinity. Construction of the MRGO, which breaches the natural barrier of the Bayou La Loutre ridge and the Pontchartrain/Borgne land bridge, allowed saline waters to push farther into the basin. Relative sea level rise of up to 0.96 feet per century gives saltier waters greater access to basin wetlands. Mean monthly salinities have increased since the construction of the MRGO and other canals. However, these mean increases are less than the overall variability in salinity. In recent years, salinities have stabilized. The heightened salinity, caused mainly by subsidence, stresses wetlands, especially fresh marsh and swamp.

A second critical problem, occurring in the lower basin, is the erosion along the MRGO caused by ship-induced waves. The channel's north bank continues to eroding at a rate of 15 feet per year. This mechanism has resulted in the direct loss of over 1,700 acres of marsh since 1968.

The third critical problem is the potential loss of the Pontchartrain/Borgne and the Pontchartrain/Maurepas land bridges where wetland soils are especially vulnerable to erosion. Since 1932, approximately 24 percent of the Pontchartrain/Borgne Land Bridge has been lost to estuarine processes such as severe shoreline retreat and rapid tidal fluctuations, and the loss rate is increasing. During the same time, 17 percent of the Pontchartrain/Maurepas Land Bridge marshes disappeared due to subsidence and spikes in lake salinity. In addition, from 1968 to 1988, 32 percent of the cypress swamp on this land bridge either converted to marsh or became open water. These land bridges prevent estuarine processes, such as increased salinities and tidal scour, from pushing further into the middle and upper basins. If these buffers are not preserved, the land loss rates around Lakes Pontchartrain and Maurepas will increase dramatically.

The fourth critical problem is that several marshes in the basin are vulnerable to rapid loss if adequate protection is not provided soon. Examples of theses areas are: marshes adjacent to lakes and bays where if the narrow rim of shore is lost, interior erosion will increase dramatically; the perched fresh marsh on the MRGO disposal area which will drain and revegetate with shrub unless the back levee dikes are repaired; and near Bayou St. Malo, where unless canals are plugged, rapid water level fluctuations and salinity intrusion into adjacent marshes will continue.

Site specific problems of shoreline erosion, poor drainage, salinity stress, and herbivory are apparent throughout the basin. Solving these problems is important, but less urgent than solving the four critical problems described above.

FUTURE WITHOUT-PROJECT CONDITIONS

If nothing is done, and marsh loss continues at the pace set from 1974-1990, another 62,400 acres, or 23 percent of the basin's existing marshes, would be lost by the year 2040, as displayed in Table PO-1. If no action is taken, 69,400 acres of swamp, 32 percent of the basin's existing swamp, would be converted to marsh or open water by 2040. This does not include the possible loss of the upper basin swamps. As the land bridges are lost, estuarine processes would push farther into the basin and erosion rates would increase. The middle basin would be a lake surrounded by shallow ponds where marshes once existed. The lower basin marshes would be a tattered remnant of what exists today. Fewer fish and shellfish would be available for commercial or recreational fishermen. Vast marshes for wintering ducks would no longer exist. The emerging ecotourism industry would be hindered, and storm surge protection would be lost as lakes and bays inched closer to levees and roads.

Table PO-1
Projected Marsh and Swamp Loss

	Projected Loss in 20 years		Projected loss in 50 years	
Subbasin	(Acres)	(Percent)	(Acres)	(Percent)
Upper Basin				
Swamp	0	0	0	0
Pontchartrain/Maurepas Land Bridge				
Swamp	23,200	38	58,000	95
Marsh	1,320	6	3,300	15
Middle Basin				
Swamp	9,600	62	11,400	74
Marsh	3,800	12	9,500	30
Pontchartrain/Borgne Land Bridge				
Marsh	4,560	10	11,400	30
Lower Basin				
Marsh	14,580	9	36,450	24
Pearl River Basin				
Marsh	700	4	1,750	10
Total Swamp Loss	32,800	15	69,400	32
Total Marsh Loss	24,960	9	62,400	23

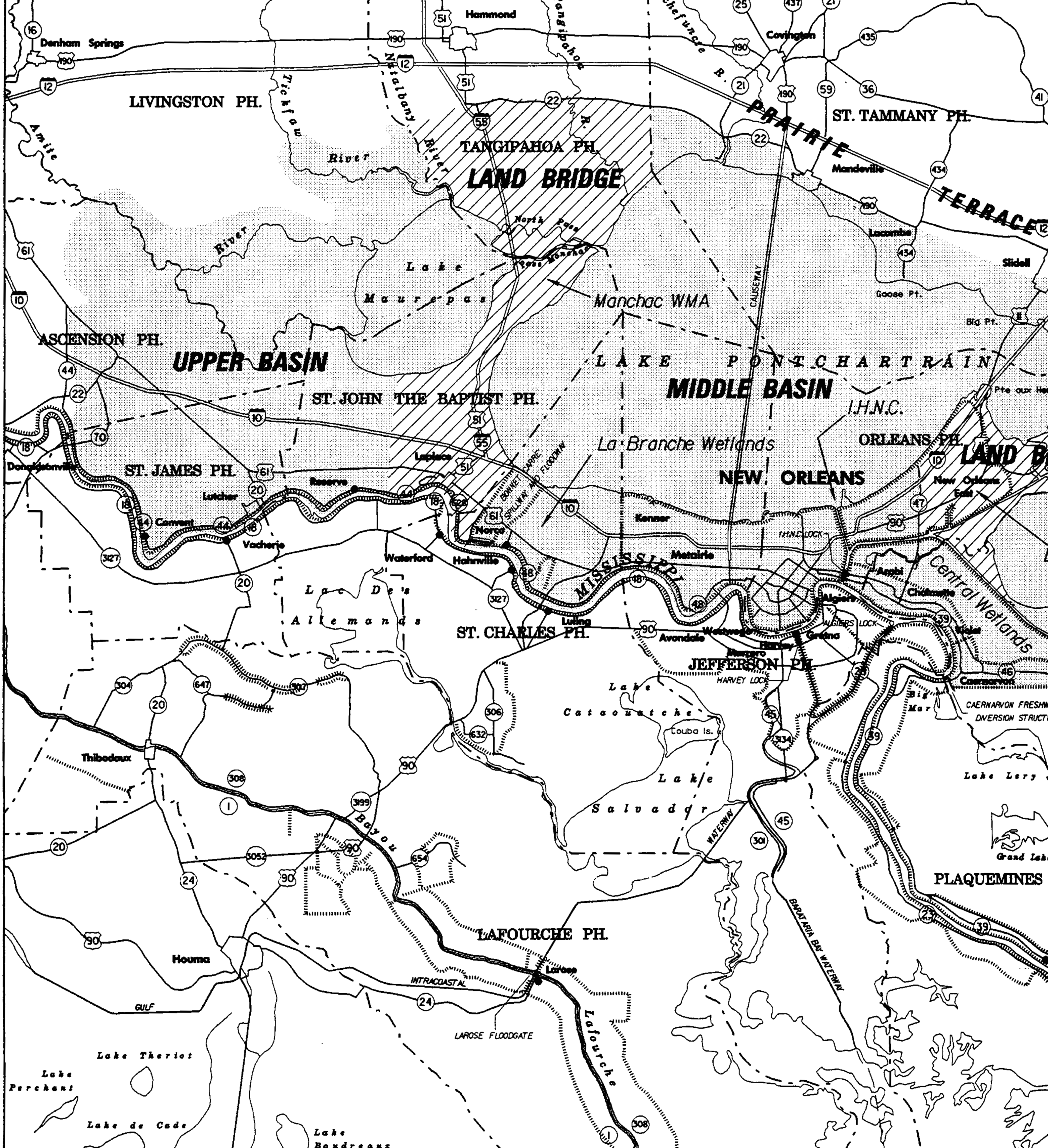
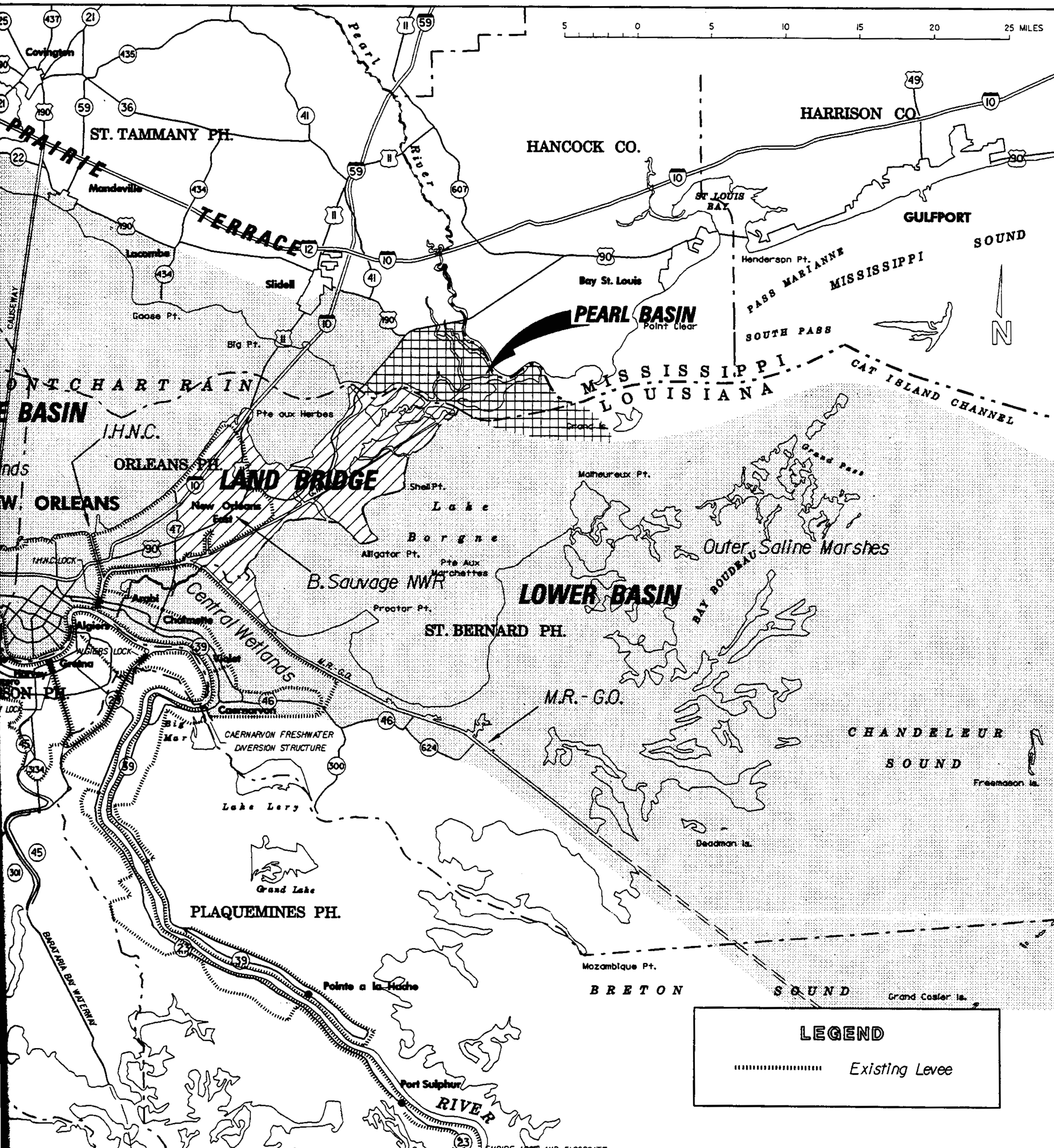


Figure PO-1. Pontchartrain Basin, Basin and Subbasin Boundaries.


PEARL BASIN
LAND BRIDGE
LOWER BASIN
Central Wetlands
Outer Saline Marshes
B. Sauvage NWR
M.R.-G.O.
I.H.N.C.
CAERNARVON FRESHWATER DIVERSION STRUCTURE
EMPIRE LOCK AND FLOODGATE
ST. TAMMANY PH.
ORLEANS PH.
ST. BERNARD PH.
PLAQUEMINES PH.
HANCOCK CO.
HARRISON CO.
MISSISSIPPI
LOUISIANA
PRAIRIE TERRACE
MISSISSIPPI SOUND
CHANDELEUR SOUND
BRETON SOUND
Lake Borgne
CAT ISLAND CHANNEL
Covington
Mandeville
Lacombe
Slidell
Bay St. Louis
GULFPORT
NEW ORLEANS
New Orleans East
Chalmette
Algiers
Gretna
Arabi
Violet
Caernarvon
Pointe a la Hache
Port Sulphur
RIVER
Grand Lake
Lake Lery
Big Mar
Mozambique Pt.
Deadman Is.
Freemason Is.
Grand Cosler Is.
Malheureux Pt.
Shell Pt.
Alligator Pt.
Proctor Pt.
Pte Aux Marchettes
Pte aux Herbes
Goose Pt.
Big Pt.
Point Clear
Henderson Pt.
PASS MARIANNE
SOUTH PASS
ST LOUIS BAY
BAY BOUDREAU
Grand Pass
I.H.N.C. LOCK
ALGIERS LOCK
BARATARIA BAY WATERWAY
5 0 5 10 15 20 25 MILES
N
LEGEND
Existing Levee

s.

BASIN PLAN

The main strategies of the basin plan are shown in Figure PO-2. Restoration of riverine input into the basin via freshwater diversion from the Mississippi River through the Bonnet Carré Spillway solves the first critical problem, salinity. This is preferred to the strategy of a navigable gate in the MRGO because the diversion has the added benefit of restoring fluvial input and is less costly overall and on a per-acre basis. The project is already authorized and need not be funded under the CWPPRA. An outfall management plan for the diversion is critical. Construction of a rock dike on the north bank of the MRGO and the beneficial use of all the material dredged for the MRGO would stop erosion, addressing the second critical problem, and create large amounts of marsh. The diversion at the Bonnet Carré Spillway and bank protection with marsh creation along the MRGO are critical projects.

Additional short-term projects include the following.

- Preservation of the land bridges through shoreline protection, hydrologic restoration, and marsh management solves the third critical problem. Various critical projects reduce future marsh loss rates and prevent estuarine processes from pushing farther into Lakes Pontchartrain and Maurepas.
- Preservation of the several marshes in the basin which are immediately vulnerable to loss is crucial to resolving the fourth critical problem. Projects which protect shorelines in several critical areas, preserve the fresh marshes on the MRGO disposal area, and retain the brackish marshes in the St. Malo area all require quick implementation.
- Several site specific areas of loss are scattered throughout the basin. Small-scale measures to preserve, restore, and enhance these marshes and swamps are important. These supporting projects should be considered once the more critical projects are in place.

In the long term, getting more fresh water and nutrients into the basin is critical. Five small-scale freshwater diversions into swamps and marshes of the basin are proposed. First, however, a study on the sediment and water budget for the Mississippi River must be completed.

Going beyond these diversions to achieve no net loss of wetlands in the long term depends on cost-effective importation of sediment either by diversions or by dedicated dredging with dispersal by barging or pipelines. This critical long-term strategy could significantly reduce wetland loss in the basin, but it is very costly at this time.

Creation of artificial barrier islands could preserve the outer saline marshes. Although expensive, it is defined as critical and retained in the selected plan for possible implementation in the long term. Studies are planned on methods to reduce the cost of construction and to better evaluate benefits to interior marshes. If costs can be reduced and benefits increased, priority for implementing this strategy will increase.

The selected plan uses a combination of measures to achieve basin objectives. Projects accounting for the majority of the acres preserved or created are distributed in the following manner: hydrologic restoration (27 percent), freshwater diversion/outfall management (28 percent), shoreline protection (24 percent), and marsh creation (18 percent).

In summary, the short-term portion of the basin plan consists of the freshwater diversion at the Bonnet Carré Spillway and bank protection and marsh creation along the MRGO complemented by the preservation of the land bridges, critical areas, and other wetlands using numerous hydrologic restoration, marsh creation, and shoreline protection projects. The long-term portion of the plan, necessary to achieve a no net loss of wetlands, consists of additional freshwater diversions, sediment import, and the creation of barrier islands.

Projects included in the Pontchartrain Basin Plan are listed in Table PO-2. The table provides the classification (e.g., critical, supportive, demonstration), estimated benefits and costs, and status of these projects. A complete listing of all the projects proposed for the Pontchartrain Basin can be found in Appendix A, Table 8. More detailed information on each project is also included in Appendix A.

COSTS AND BENEFITS

An expenditure of $132,738,000 on short-term projects and $72,000,000 on construction and 20 years of maintenance of the Bonnet Carré Freshwater Diversion will create or preserve 17,320 acres of marsh and 3,600 acres of swamp and thus prevent 69 percent of the marsh loss and 7 percent of the swamp loss in the Pontchartrain Basin (see Table PO-3).

As shown in the table, short-term projects prevent 83 to 92 percent of the future marsh loss on the land bridges and achieve no net loss of marsh in the middle basin. However the plan prevents only 44 percent of the marsh loss in the lower basin. Clearly, additional long-term efforts are needed to preserve these eroding marshes. Construction of the artificial barrier islands prevents the loss of an additional 33 percent of the lower basin. However, the cost of barrier island creation, using present technology, is an additional $600 million. Long-term sediment import projects are essential in achieving no net loss in the lower basin. Sediment import into the upper basin is necessary to begin to preserve its cypress swamps. The cost of these sediment import projects is unknown. Thus, complete restoration of the upper and lower basins requires investigation of cost effective techniques to build barrier islands and import sediment.

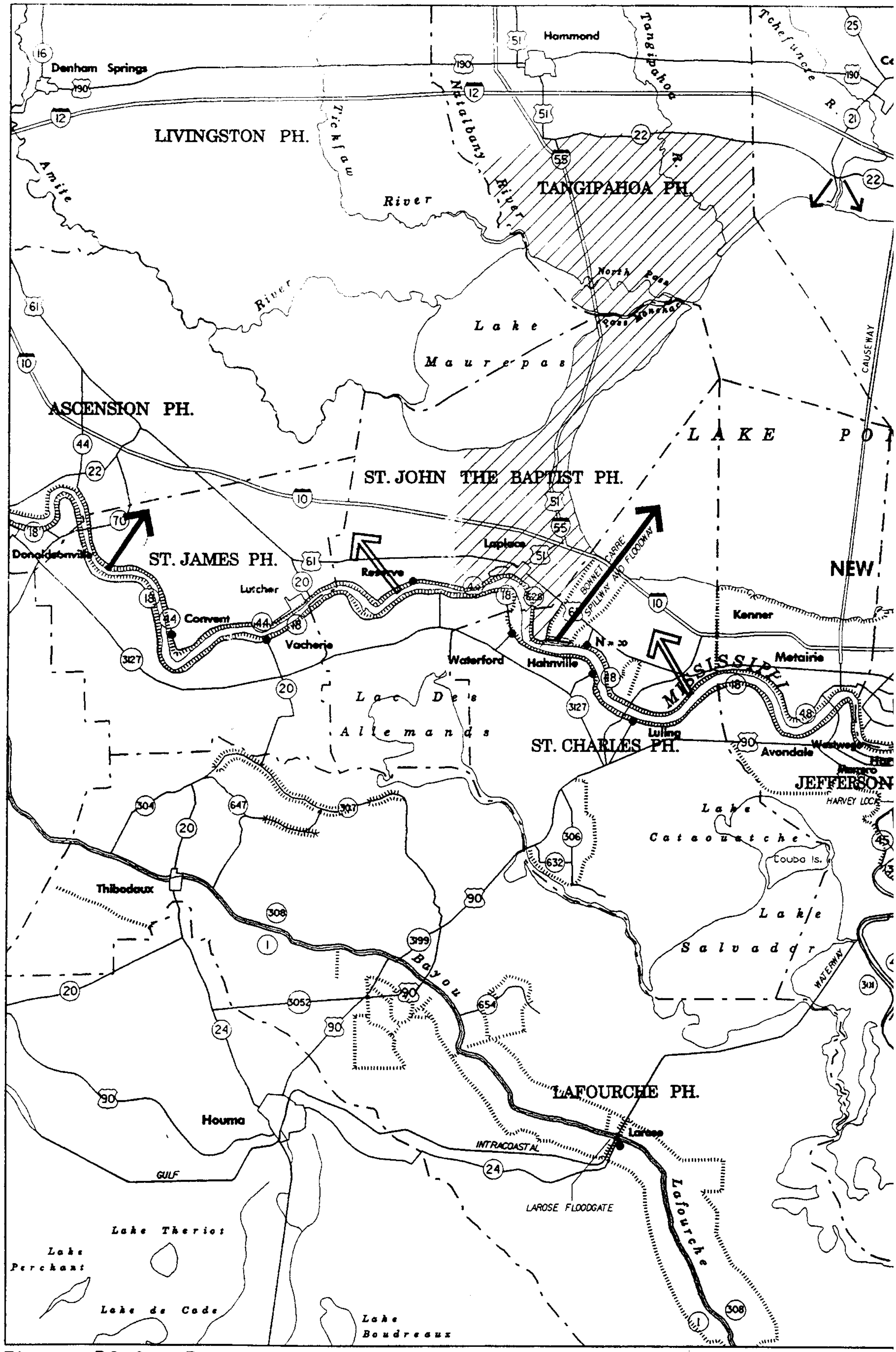
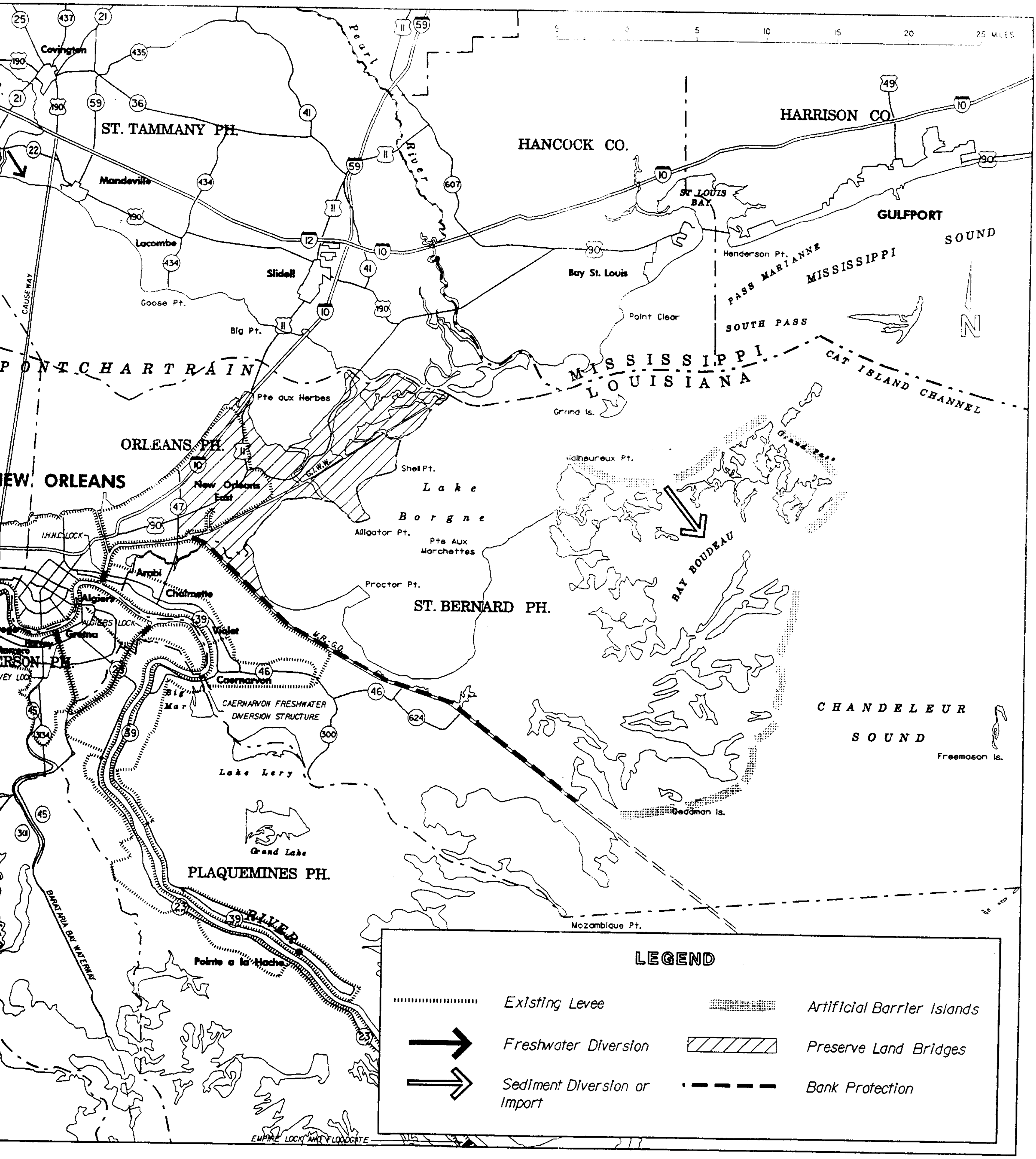


Figure PO-2. Pontchartrain Basin, Strategy Map.



5 0 5 10 15 20 25 MILES
Covington
Pearl River
ST. TAMMANY PH.
HANCOCK CO.
HARRISON CO.
Mandeville
ST LOUIS BAY
GULFPORT
Lacombe
Slidell
Bay St. Louis
Henderson Pt.
PASS MARIANNE
MISSISSIPPI SOUND
Goose Pt.
Point Clear
SOUTH PASS
Big Pt.
CAUSEWAY
PONTCHARTRAIN
MISSISSIPPI
LOUISIANA
CAT ISLAND CHANNEL
Pte aux Herbes
Grand Is.
ORLEANS PH.
Malheureux Pt.
Grand Pass
NEW ORLEANS
New Orleans East
G.I.W.W.
Shell Pt.
Lake Borgne
I.H.N.C. LOCK
Alligator Pt.
Pte Aux Marchettes
BAY BOUDEAU
Arabi
Proctor Pt.
Chalmette
Algiers
ST. BERNARD PH.
ALGIERS LOCK
Violet
Gretna
Harvey
M.R.-G.O.
Caernarvon
Big Mar
CAERNARVON FRESHWATER DIVERSION STRUCTURE
CHANDELEUR SOUND
Freemason Is.
Lake Lery
Grand Lake
Beadman Is.
PLAQUEMINES PH.
BARATARIA BAY WATERWAY
RIVER
Mozambique Pt.
Pointe a la Hache
EMPIRE LOCK AND FLOODGATE
LEGEND
Existing Levee
Artificial Barrier Islands
Freshwater Diversion
Preserve Land Bridges
Sediment Diversion or Import
Bank Protection

Table PO-2

Summary of Pontchartrain Basin Projects

Project No.	Project Name	Project Type	Priority List Project	Marsh Acres Created, Protected, or Restored	Swamp Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comment
Critical Projects, Short-Term									
PO-6	Fritchie Wetland Hydrologic Restortation	HR, FD	PPL 2	1,040		1,686	2,297,000	1,400	
PO-11	Cutoff Bayou Hydrologic Restoration	HR		103		503	722,000	1,400	
PO-13	Tangipahoa/Pontchartrain Shore Protect	SP		142		627	4,850,000	7,700	
PO-14	Green Point/Goose Point Marsh Rest	SP		249		1,026	3,252,000	3,200	
PO-15	Alligator Point Marsh Restortation	HR		139		1,489	1,575,000	1,100	
PPO-2a	Lk Borgne SP, Rigolets to Chef	SP		84		94	1,421,000	15,100	
PPO-2b	Lk Borgne SP, South of Bienvenue	SP		41		91	578,000	6,400	
PPO-2g	Lk Borgne SP, Chef to GIWW Bypass	SP		81		96	1,708,000	17,800	
PPO-7	La Branche Shore Protection, East	SP		524		1,083	1,309,000	1,200	
PPO-10	La Branche Marsh Creation, West	MC	PPL 1	205		266	4,087,000	15,400	
PPO-19	Highway 51/Railroad Culverts	HR			73	283	342,000	1,200	
PPO-38	MRGO Bank Stabilization and MC	MC, SP		4,220		6,745	54,500,000	8,100	
XPO-50a	Lk Maurepas SP, Blayhut Canal	SP		162		631	1,728,000	2,700	
XPO-50b	Lk Maurepas SP, W Jones Island	SP		118		164	2,044,000	12,500	
XPO-51	Manchac WMA Marsh Management	MM		454	32	1,195	1,021,000	900	
XPO-52a	B Sauvage NWR HR, Hwy 90 to GIWW	HM	PPL 1	1,550		1,953	1,448,000	700	
XPO-52b	B Sauvage NWR HR, Hwy 90 to I-10	HM	PPL 2	1,280		2,077	1,114,000	500	
XPO-54	Bonnet Carre, Outfall Management	OM		1,000	300	1,300	8,500,000	6,500	
XPO-55	Bonnet Carre Diversion, 30,000 cfs	FD		1,560	2,450	4,010	72,000,000	18,000	Authorized USACE project
XPO-58	Pass Manchac Shore Protection	SP		72		107	1,745,000	16,300	
XPO-69	B Sauvage NWR, B Chevee SP	SP		468		1,367	2,672,000	2,000	
XPO-70	Lk Pontchartrain SP, Bon Car to Ruddock	SP		25	124	188	1,867,000	9,900	
XPO-71	MRGO Disposal Area Marsh Protection	HR	PPL 3	755		775	434,000	600	
XPO-81	Pt au Herbes Shore Protection	SP		42		49	590,000	12,000	
XPO-83	Lk Athanasio Spit Marsh Creation	MC		99		1,713	895,000	500	
XPO-84	St. Malo Hydrologic Restoration	HR		2		122	658,000	5,400	
XPO-91	La Branche SP, Walker Canal to Blowhole	SP		19		37	351,000	9,500	
Subtotal: Critical Projects, Short-Term				12,870	530	25,670	101,708,000		Total does not include Bonnet Carre FWD

Table PO-2 (Continued)
Summary of Pontchartrain Basin Projects

Project No.	Project Name	Project Type	Priority List Project	Marsh Acres Created, Protected, or Restored	Swamp Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comment
Critical Projects, Long-Term									
PPO-27	Tchefuncte Freshwater Diversion, West	FD							
PPO-28	Tchefuncte Freshwater Diversion, East	FD							
XPO-45	Upper/Middle Basin Sediment Pumping	SD							Feasibility study of water and sediment first
XPO-46	Tickfaw Freshwater Diversion	FD							
XPO-66	Artificial Barrier Is on Saline Marsh Fringe	BI							
XPO-85	Bayou Manchac Diversion	FD							
XPO-89	Blind River Freshwater Diversion	FD							
XPO-90	Sediment Input Lower Basin	MC							
Supporting Projects, Short-Term									
PO-7	North Shore Wetlands	ST		22		1,213	488,000	400	
PO-9a	Violet Outfall Management	HR	PPL3	247		1,124	1,364,000	1,200	
PPO-2c	Lk Borgne SP, Proctor Point	SP		99		143	651,000	4,600	
PPO-2d	Lk Borgne SP, East of Shell Beach	SP		246		383	1,664,000	4,300	
PPO-2e	Lk Borgne SP, Point au Marchettes	SP		106		121	1,056,000	8,700	
PPO-2f	Lk Borgne SP, South of Malheureaux Pt	SP		49		52	651,000	12,500	
PPO-4	Eden Isles East Marsh Restoration	HM, MC		1,092		1,494	8,856,000	5,900	Cost does not include land purchase
PPO-9	La Branche Marsh Creation, East	MC		733		830	9,937,000	12,000	
PPO-12	Tchefuncte Marsh Shore Protection	SP		81		152	854,000	5,600	
PPO-13	B Chinchuba Marsh Shore Protection	SP		42		63	752,000	11,900	
PPO-31	Indian Beach Marsh Creation	MC		11		34	464,000	13,600	
XPO-47	Amite River Diversion Canal Bank Mod	SP			340	596	533,000	900	
XPO-48a	Tennessee Williams Canal Bank Mod	HR			70	122	269,000	2,200	
XPO-48b	Hope Canal Bank Modification	HR			160	281	290,000	1,000	
XPO-63	Lk Maurepas SP, Mouth of Blind River	SP		14	48	73	1,096,000	15,000	
XPO-72	MRGO MC, (Material From 9-23 to Jetties)	MC							
XPO-74	Bienvenue Marsh	OM, MC							
XPO-80a	Lower Pearl Basin Sediment Trapping	ST		55		2,940	660,000	200	
XPO-82	Fontainbleau Shore Protection	SP		16		28	246,000	8,800	
XPO-88	Point Platt Sediment Trapping	ST		74		1,138	1,199,000	1,100	
XPO-94	Lake Pontchartrain Grassbeds	ST							
Subtotal: Supporting Projects, Short-Term				2,890	620	10,790	31,030,000		

Table PO-2 (Continued)
Summary of Pontchartrain Basin Projects

Project No.	Project Name	Project Type	Priority List Project	Marsh Acres Created, Protected, or Restored	Swamp Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comment
Supporting Projects, Long-Term									
PPO-17	Amite/Petite Amite Swamp Restoration	HR							
PPO-36	GIWW Bank Stab, Rigolets to MRGO	SP							
XPO-59	North Shore Marsh Rest w/ Dredged Mat	MC							
XPO-60	Ascension Parish Swamp Restoration	HR							
XPO-61	St. James/St. John Swamp Restoration	HR							
XPO-64	B Sauvage NWR Hyd Rest, I-10 to Lake	HM							
XPO-73	MRGO Bar Wetland Creation	MC							
XPO-75	St. Bernard Brackish Marsh	HR							
XPO-76	Pontchatoula Marsh	HR							
XPO-77	GIWW Northern Marsh, Chief to Rigolets	HR							
XPO-78	Tangipahoa/Bedico Marsh	HR							
XPO-79	Jones Island Marsh	HR							
XPO-80	Pearl River Marsh	FD, HR							
Demonstration Projects									
PPO-21	N.O. East, Marsh Creation for Stormwater	MC							
PPO-25	Bayou St. John Grassbeds	VP							
PPO-34	Bonnabel Canal, Marsh Creation Stormwater	MC							
XPO-47	Amite R Div Canal Bank Modification	HR							
XPO-92	Shoreline Protection Demonstration Methods	SP							
XPO-93	N.O. East Marsh Creation W/ Biosolids	MC							
Defferred Projects									
PO-1b	Violet Siphon Enlargement	FD							Consider after PO-9a
PO-5	SE Lake Maurepas Wetlands	HR							Defer until cost & Benefits are known
PO-12	La Branch Wetland Management, West	HR							Defer until cost & Benefits are known
PPO-20	Port Louis Hydrologic Restoration	HR ,MC							Landowner not interesed
PPO-35	Duncan Canal, Marsh Creation Stormwater	MC							Defer until other stormwater demo's done
XPO-49	Tangipahoa Swamp Hydrologic Rest	HR							Defer until Bonnet Carre benefits are realized
XPO-56b	Seabrook Sill	HR							
XPO-65	Artificial Oyster Reefs	SP							Defer until results of similar demo's known
Total Pontchartrain Basin *				15,760	1,150	36,460	132,738,000		Includes Short-Term Projects Only
Total Pontchartrain Basin with Bonnet Carre Freshwater Diversion **				17,320	3,600	40,470	204,738,000		Includes Short-Term Projects and Bonnet Carre

BI Barrier Island Restoration
FD Freshwater Divesion
HM Hydrologic Management of Impoundments
HR Hydrologic Restoration
MC Marsh Creation
MM Marsh Management
OM Outfall Management
SD Sediment Diversion
SP Shoreline or Bank Protection
ST Sediment Trapping
VP Vegetative Planting

* Total cost and benefits for the basin plan include only Critical Short-Term Projects and Supporting Short-Term Projects.

** Total cost and benefits include only Critical Short-Term, Supporting Short-Term, and the Bonnet Carre Freshwater Diversion project.

Table PO-3. Results of Short Term Projects and Bonnet Carre Diversion

Area	CWPPRA Net Acres Marsh Created/ Preserved	CWPPRA Net Acres Swamp Created/ Preserved	CWPPRA Estimated Cost x $(1000)	Bon. Carre Net Acres Marsh Created/ Preserved	Bon. Carre Net Acres Swamp Created/ Preserved	Bon. Carre Estimated Cost x $(1000)	Total plan Net Acres Marsh Created/ Preserved	Total plan Net Acres Swamp Created/ Preserved	Total plan Percent Marsh Loss Prevented	Total plan Percent Swamp Loss Prevented
Upper Basin	10	620	2,188	0	0	0	0	620	0	3
Pontch/Maur Land Bridge	970	230	13,597	130	1960	37,520	1100	2,190	83	9
Middle Basin	5,110	300	42,592	420	490	16,500	5530	790	145	8
Pontch/Borgne Land Bridge	3,790	0	11,828	420	0	7,480	4210	0	92	0
Lower Basin	5,830	0	61,873	600	0	10,500	6430	0	44	0
Pearl Basin	60	0	660	0	0	0	60	0	9	0
Total	15,770	1,150	132,738	1,570	2,450	72,000	17,330	3,600	69	7

* Bonnet Carre Diversion benefits and costs were estimated for 20 years to be comparable to CWPPRA acres and costs.

The 4,000 acres and $72,000,000 were distributed to the land bridges, the middle basin, and the lower basin.

BRETON SOUND BASIN: SUMMARY OF BASIN PLAN

STUDY AREA

The Breton Sound Basin encompasses approximately 676,400 acres, of which 184,100 acres are wetlands. It is bounded on the west by the Mississippi River, on the north by Bayou La Loutre, on the east by the south bank of the Mississippi River Gulf Outlet (MRGO), and on the south by Baptiste Collette Bayou and Breton Island (Figure BS-1). The basin includes portions of Plaquemine and St. Bernard parishes. It consists of approximately 51,300 acres of public land, equaling 28 percent of the total lands within the basin.

EXISTING CONDITIONS AND PROBLEMS

The Breton Sound Basin is the remnant of a Mississippi River delta lobe, the abandoned St. Bernard Delta. The principal hydrologic features of the Breton Sound Basin include the Mississippi River and its natural levee ridges; the flood protection levee; the MRGO south disposal bank; Bayou Terre aux Boeufs and River aux Chenes (abandoned delta distributaries); and the freshwater diversions at Caernarvon, White's Ditch, Bohemia, and Bayou Lamoque.

The natural processes of subsidence, saltwater intrusion, and erosion of wetlands, and the human effects of river levee construction and the oil and gas industry, have caused major impacts to the Breton Sound Basin in recent decades. The two major wetland problems resulting from the natural processes and human intervention in this basin are sediment deprivation and saltwater intrusion.

Historically, the basin was flushed with large quantities of fresh water and sediments annually during the spring. Marine waters would then rise and enter the basin during the late summer and early fall months and would be flushed out the following spring. In the early 1930's, flood protection levees were raised along the Mississippi River as far south as Bohemia in the Breton Sound Basin. This prevented the annual input of fresh water, nutrients, and sediment that nourished the wetlands and combatted saltwater intrusion.

Between 1940 and 1970, 12.9 square miles (8,256 acres) of canals were dredged across and between the abandoned distributary ridges that run from the river to the outer fringes of the marsh (Gagliano et al., 1970). This has allowed channelized outflow of fresh water and increased tidal flux.

The combination of natural processes and human intervention has allowed salt water to enter close to the head of the basin. Much of the fresh and intermediate marsh that occurred in the upper basin earlier in this century has either converted to more saline habitats or has become open water as a result of sediment and nutrient deprivation brought about by the construction of flood protection levees and saltwater intrusion caused by the dredging of oil and gas access canals through and between the natural distributary ridges.

Subsidence combined with sediment and nutrient deprivation has contributed greatly to the marsh loss in the upper and middle basin and even more greatly in the Bohemia Subbasin. The subsidence rate ranges from 0.6 feet per century in the upper portion of the basin to 4 feet per century in the lower portion. The effect of subsidence is very apparent in the area south of Bohemia, which was created by alluvial deposits of the Mississippi River less than 1,000 years ago. Large areas of wetlands flanking the Mississippi River in this area have subsided and are continuing to subside and convert to open water. Periodic overbank flows from the

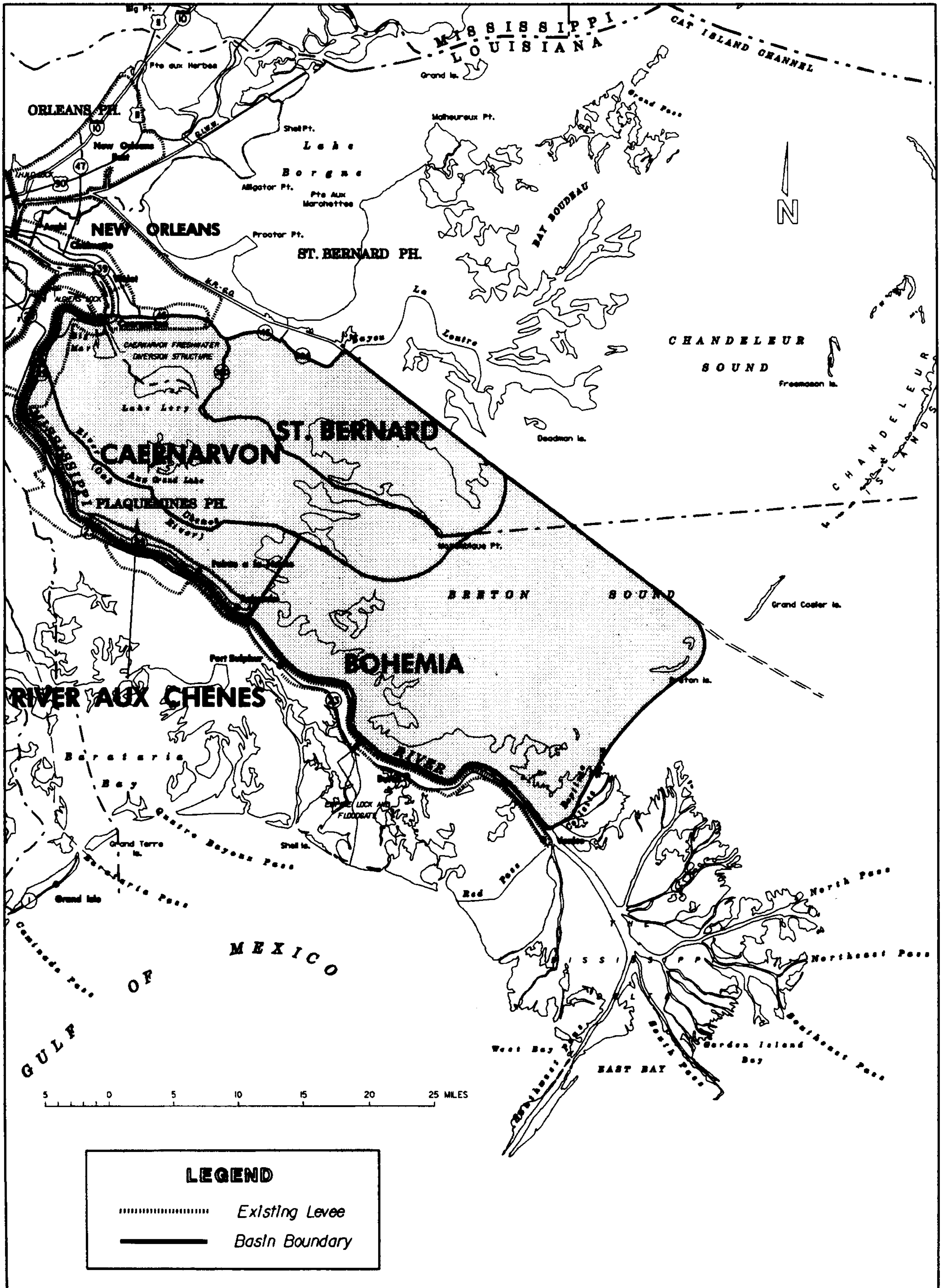


Figure BS-1. Breton Sound Basin, Basin and Subbasin Boundaries.

Mississippi River occur in this area, and some wetlands immediately adjacent to the river are being maintained by this input of sediments and fresh water.

A significant cause of wetland loss in the Breton Sound Basin is erosion of shorelines by wind-wave action. Along the shoreline of the outer marshes and around the perimeter of the larger bays, erosion rates of 5 to 10 feet per year are common. These high rates occur in the fringe marshes because the Breton barrier islands are so far offshore that they offer little protection to the estuary behind them.

FUTURE WITHOUT-PROJECT CONDITIONS

Table BS-1 shows the losses estimated over the next 20 and 50 years based on 1974-1990 loss rates from Table 2.

Table BS-1
Projected Marsh Loss

	Projected Loss in 20 years		Projected Loss in 50 years	
Subbasin	(Acres)	(Percent)	(Acres)	(Percent)
River aux Chenes	500	2	1,230	4
Caernarvon	5,100	7	12,760	16
St. Bernard	2,300	6	5,760	14
Bohemia	5,480	16	13,720	41
Total	13,380	7.3	33,470	18.2

The effects of the Caernarvon Freshwater Diversion Structure, which is expected to preserve 320 acres per year for 50 years or 16,000 acres, are reflected in the projected losses for the Breton Sound Basin.

Marsh loss will continue in the upper and middle parts of the basin where sediments from the Caernarvon structure are insufficient to offset impoundment and sediment deprivation. The marshes in the lower basin will continue to deteriorate from wind-generated wave action and tidal scour, following the general abandoned delta break-up process. Marshes south of Bohemia will continue to subside, erode, and convert to open water except for those areas nearest the river, which will be maintained by periodic overbank flow.

The economies of communities in the basin are largely based upon oil and gas and renewable biological resources. Fishery harvests have increased, largely due to increased numbers of harvesters, each of which is harvesting less per man-hour than was harvested ten years ago.

BASIN PLAN

The selected plan (Figure BS-2) provides a balanced approach to create, restore, protect, and enhance wetlands through the optimization of the available resources afforded the basin. Management and restoration of fluvial input form the foundation of the selected plan. In the short term, management of the Caernarvon Freshwater Diversion Structure's outfall along with outfall management of White's Ditch, Bohemia, and Bayou Lamoque Freshwater Diversions is vital to the restoration of this basin because such projects will help to maintain and restore the hydrology of the basin. Also, in the short term, construction of a small-scale controlled sediment diversion at Grand Bay and the restoration of overbank flow at Olga will create and nourish marsh through sediment transport.

Restoration of fluvial input to the basin through the construction of a 20,000-cfs sediment diversion, tentatively at Bohemia, is the core of the long-term strategy to restore the basin. A feasibility study is necessary to determine the optimum location for such a diversion. In support of the long-term strategies, construction of interior barriers and the restoration of natural ridges will help to restore the natural compartmentalized hydrology within the basin.

Projects selected for inclusion in the Breton Sound Basin plan are listed in Table BS-2. The table indicates project type; classification (i.e., critical, supporting); project status; acres created, restored, or protected; net benefited acres; cost per benefited acre; and the estimated project cost.

COSTS AND BENEFITS

The proposed projects, short- and long-term critical and short-term supporting, will create, restore, or protect approximately 5,200 acres, 39 percent of the predicted loss at an estimated cost of $11,367,000. Including submerged aquatic vegetation and enhancement of existing marsh, an additional 4,400 acres will benefit from plan implementation.

The selected plan provides a balanced approach to improving conditions in the basin. Hydrologic restoration measures such as outfall management and sediment diversion account for the majority of the acres created, restored, and protected.

If cost-effective construction techniques are developed, the Fiddler Point Barrier Island project could be implemented. This project would protect an additional 1,190 acres, preventing 10 percent of the projected loss. The cost of constructing this barrier island system using present technology is estimated to be $55,115,000. The cost per acre is $118,000 and is nearly 30 times the average cost per acre of the other proposed projects. Thus, the recommendation is to proceed with the rest of the plan and postpone barrier island construction until techniques are developed to decrease their cost.

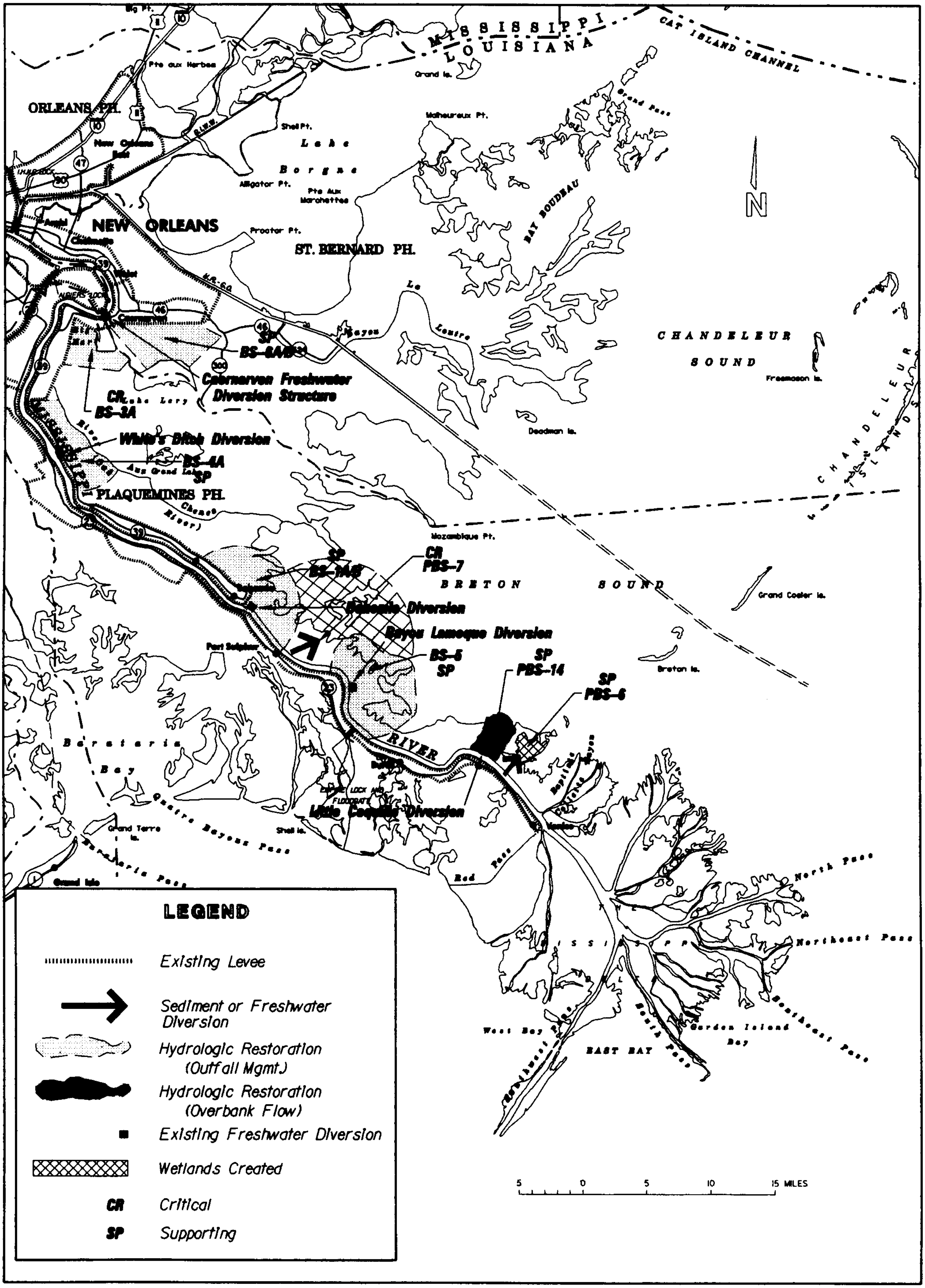


Figure BS-2. Breton Sound Basin, Selected Plan.

Table BS-2
Summary of the Breton Sound Basin Projects

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
<u>Critical Project, Short-Term</u>								
BS-3a	Caernarvon Diversion Outfall Mgmt S. of Big Mar	OM	PPL2	812	1,758	1,885,000	1,100	Interacts w/ BS-4a
<u>Critical Project, Long-Term</u>								
PBS-7	Bohemia Sediment Diversion (large scale diversion)	SD		* 3,350	4,760	3,118,000	700	Compatible with PBS-4
<u>Supporting Projects, Short-Term</u>								
BS-1a/b	Restoration of Bohemia Diversion and O/F Mgmt	OM		124	658	1,642,000	2,500	Interacts w/ PBS-7 and BS-1a/b
BS-4a	White's Ditch Outfall Management	OM	PPL3	37	305	601,000	2,000	Interacts w/ BS-3a
BS-5	Bayou Lamoque Diversion Outfall Management	OM		350	555	317,000	600	Interacts w/ PBS-7 and BS-1a/b, Can PPL 3
BS-6a/b	Pump Outfall Management N. of Lake Lery	OM		169	746	2,241,000	3,000	Interacts w/ BS-3a, Candidate PPL 3
PBS-6	Grand Bay Crevasse	SD		364	800	1,563,000	2,000	Interacts w/ PBS-14, Candidate PPL 2, 3
PBS-14	Foreshore Dike Restoration at Olga	HR						Interacts w/ PBS-6
Subtotal:	Supporting Projects, Short-Term			1,040	3,060	6,364,000		
<u>Supporting Projects, Long-Term</u>								
PBS-4	Diversion of the Mississippi River into Breton Sound	SD						Compatible with PBS-7
PBS-5	Fiddler Point Barrier Island	BI						Not to be built unless cost are reduced
PBS-8	Interior Barrier	HR		* 1,875	12,480	32,000,000	2,600	To be tied into outfall mgmt plans
PBS-9	Interior Ridge Restoration and Enhancement	HR						To be built if PBS-7 is not
<u>Demonstration Project</u>								
PBS-13	Oyster Reef Demonstration	SP						Candidate PPL 2
Total Breton Sound Basin **				1,850	4,820	8,249,000		Includes only Short-Term Projects
Total Breton Sound Basin Including Long-Term Critical Projects ***				5,200	9,600	11,367,000		

BI Barrier Island Restoration — HR Hydrologic Restoration — SP Shore or Bank Protection
FD Freshwater Diversion — SD Sediment Diversion — OM Outfall Management

* Benefits not varified by the WVA work group
** Cost and benefits include only Critical Short-Term and Supporting Short-Term project
*** Cost and benefits include Critical Short and Long-Term and Supporting Short-Term projects

MISSISSIPPI RIVER DELTA BASIN: SUMMARY OF BASIN PLAN

STUDY AREA

The Mississippi River Delta Basin is defined as all of the land and shallow estuarine area between the two northernmost passes of the Mississippi River and the Gulf of Mexico. The basin is located in Plaquemines Parish, Louisiana, south of the city of Venice. Baptiste Collette Bayou, on the east side of the river, and Red Pass, on the west side, form the basin's northern boundary. This area is also referred to as the Plaquemines-Balize or "bird's foot" delta. The basin encompasses approximately 521,000 acres and is shown in Figure MR-1. Approximately 129,000 acres of land and water in this basin are in public ownership. This includes approximately 14,000 acres of the river's channel and passes which are navigable waterways of the United States.

EXISTING CONDITIONS AND PROBLEMS

The Mississippi River has had a profound effect on the landforms of coastal Louisiana. The entire area is the product of sediment deposition following the latest rise in sea level about 5,000 years ago. Each Mississippi River deltaic cycle was initiated by a gradual capture of the Mississippi River by a distributary which offered a shorter route to the Gulf of Mexico. After abandonment of an older delta lobe, which would cut off the primary supply of fresh water and sediment, an area would undergo compaction, subsidence, and erosion. The old delta lobe would begin to retreat as the gulf advanced, forming lakes, bays, and sounds. Concurrently, a new delta lobe would begin its advance gulfward. This deltaic process has, over the past 5,000 years, caused the coastline of south Louisiana to advance gulfward from 15 to 50 miles, forming the present-day coastal plain.

For the last 1,200 years, sediment deposition has occurred primarily at the mouth of the Mississippi River's Plaquemines-Balize delta, in the area defined as the Mississippi River Delta Basin. This delta is located on the edge of the continental shelf of the Gulf of Mexico. Its "bird's foot" configuration is characteristic of alluvial deposition in deep water. In this configuration large volumes of sediment are required to create land area; consequently, land is being lost in this delta more rapidly than it is being created.

The Mississippi River Delta Basin comprises approximately 521,000 acres of land and shallow estuarine water area in the active Mississippi River delta. Approximately 83 percent of this area, or 420,000 acres, is open water. The 101,100 acres of land in the basin are characterized by low relief, with the most prominent features being natural channel banks and dredged material disposal areas along the Mississippi River, its passes, and man-made channels. Coastal marshes make up approximately 61,650 acres or about 61 percent of the total land area in the Mississippi River Delta Basin. Eighty-one percent of this marsh is fresh, 17 percent is intermediate, and 2 percent is brackish-saline.

The Mississippi River discharges the headwater flows from about 41 percent of the contiguous 48 states. On a long-term daily basis, discharges in the Mississippi River average 470,000 cubic feet per second (cfs). A peak discharge of approximately 1,250,000 cfs occurs on the average of once every 16 years downstream of New Orleans.

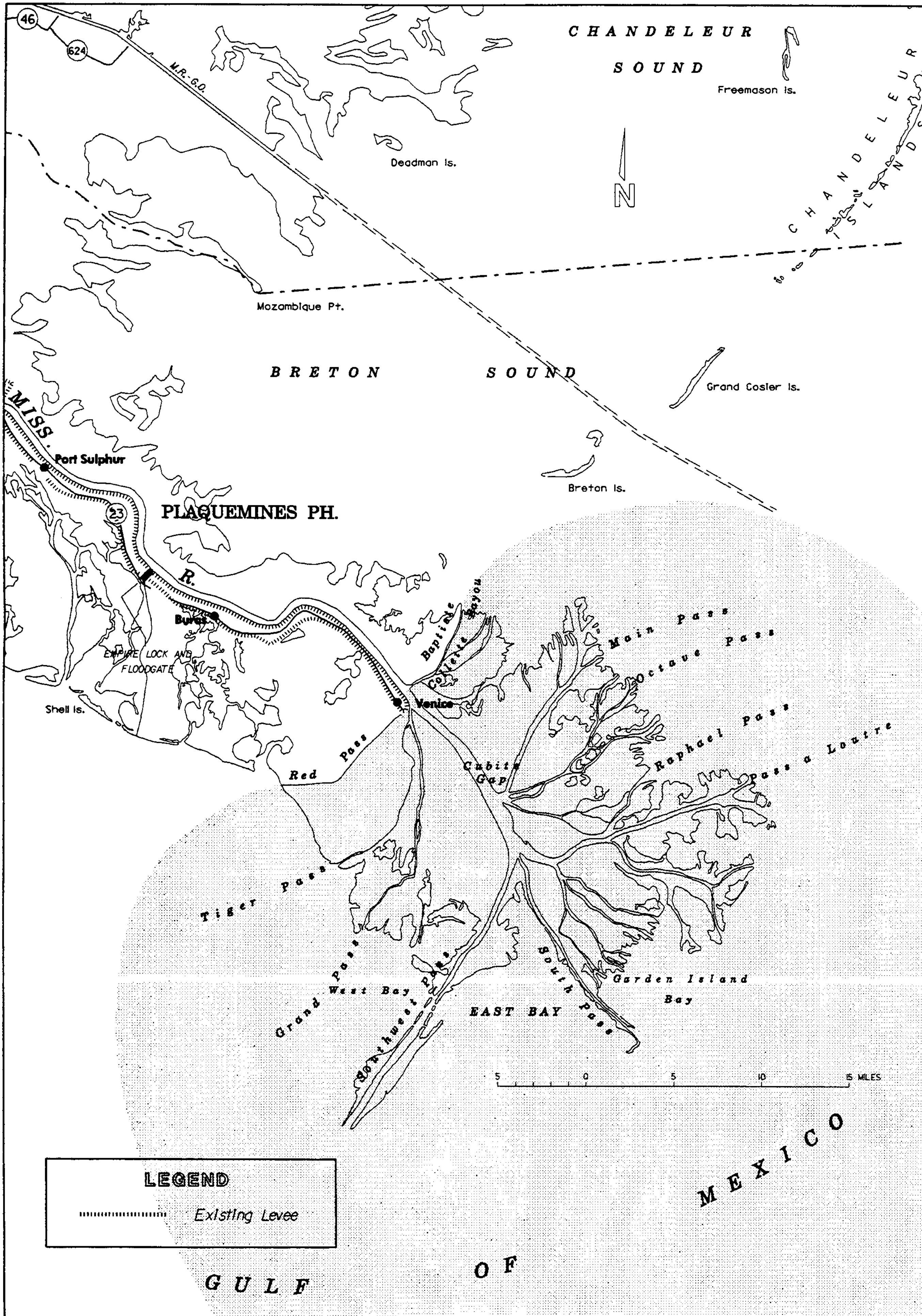


Figure MR-1. Mississippi River Delta Basin, Basin Boundaries.

Suspended sediment concentrations in the river decreased markedly between 1950 and 1966. Since that time the observed decrease in the suspended sediment load has been minimal. Long-term suspended sediment loads in the river average 436,000 tons per day; they have ranged from an average of 1,576,000 tons per day in 1951 to a still considerable average of 219,000 tons per day in 1988.

Between 1974 and 1990 the land loss rate in the Mississippi River Delta Basin averaged 1,072 acres per year, or 1.69 percent of existing land area (Dunbar, Britsch, and Kemp 1992). Between the mid-1950's and 1974, the estimated land loss rate for the basin was 2,890 acres per year. This loss is the result of compaction, subsidence, hurricanes, tidal erosion, sea level rise, and human activities. The loss has been aggravated by maintenance of navigation channels and construction of canals for mineral exploration. The total land area lost in this basin over the last 60 years has been approximately 113,300 acres.

The primary wetlands loss problem facing the Mississippi River Delta Basin is that of subsidence and compaction. Unlike other areas of coastal Louisiana, the Mississippi River delta is blessed with a relative abundance of inflowing fresh water and sediments. Despite the availability of these resources, the overall growth of emergent delta has been truncated in recent history. In its present position the Mississippi River deposits sediments into much deeper water than has been the case historically. This is evidenced by the thick stratum of Holocene deltaic sediments found in the active river delta. These unconsolidated sediments are highly susceptible to compaction, reducing the life span of emergent wetlands. While the rapid emergence of wetlands can occur over large areas in the delta, these areas deteriorate in an equally rapid manner.

Human activities have aggravated land loss rates in the Plaquemines-Balize delta. The stabilization of the Mississippi River's channel has cut off seasonal sediment-laden overbank flow that once nourished adjacent wetland areas. The Mississippi River levees to the north, and associated erosion control and channel stabilization measures extending to its mouth, also preclude the possibility of a naturally occurring crevasse or change in the river's course.

Many areas of the Louisiana coast suffer from a lack of the abundant fresh water and sediment found in the Mississippi River. Since the river is no longer free to alter its course and leave its banks to inundate vast coastal areas, the effects of human and natural forces which promote wetland deterioration are compounded. In this respect the relationship between the Mississippi River and the problems facing coastal wetlands is not limited to the river's delta, but extends across the entire Louisiana coast. The lack of growth in the Mississippi River delta, on a large scale, is as much a coast-wide problem as a basin problem. This source of ample fresh water and sediment, which shaped the Louisiana coast as we know it, is no longer producing a net gain in coastal wetlands, placing the entire Louisiana coast at risk.

FUTURE WITHOUT-PROJECT CONDITIONS

Since 1932, the Mississippi River Delta Basin has lost approximately 70 percent of its total land area. The composite of recent loss rates presented above was used to predict future wetlands losses. The total projected wetland losses over 20- and 50-year time spans represent, respectively, 35 and 87 percent of the existing wetlands in the basin and are shown in Table MR-1. Based on this loss of wetlands, only 5 percent of the original 1932 land area in this basin would remain intact in 50 years.

Table MR-1
Projected Wetland Losses

Projected Time (years)	Acres Lost	Percent Loss
20	21,440	35
50	53,600	87

BASIN PLAN

The unique opportunity present in this basin is the tremendous volume of sediment transported by the Mississippi River. The need which must be addressed with this resource is not limited to only this basin. The needs of the entire coast of Louisiana are linked, inseparably, to the unique opportunity that the Mississippi River presents.

Two alternative strategies were developed for this basin. Strategy One involves the study and development of a major uncontrolled diversion of the Mississippi River for the creation of a new delta, while maintaining the navigation route in its present location and managing the retreat of the existing delta. Strategy Two would maintain the course of the river in its present location and optimize the growth of the existing delta through redistribution of the available flows and sediments throughout this location.

The crucial point for the selection of the diversion plan, Strategy One, over Strategy Two, maintenance of the existing delta, is the extent of the benefits which can be achieved and the long-term optimization of available resources. Diversion of the river's main flow translates into large gains in newly emergent wetlands over potentially hundreds of years. It should also be recognized that the existing delta, if left to natural processes, would ultimately be abandoned and its wetlands lost.

It is also important to note that the same short-term strategy can be implemented under either major strategy. Many of the measures which can be taken to enhance the current delta configuration under Strategy Two will, in some scaled form, be used in preparing the existing delta for a diversion of the river and in managing its retreat under Strategy One. This allows the execution of the plan to proceed in the short term regardless of which major diversions may ultimately prove feasible.

Under the selected course of action, Strategy One, the proposed study would look into all viable options for undertaking the relocation of the river's primary delta. The restoration plans in both Breton Sound and Barataria basins are compatible with some form of large scale diversion as outlined in this basin. At this time the principal site for consideration is Breton Sound, although others will be evaluated.

In managing the retreat of the existing delta a number of small to moderate wetland creation projects will be undertaken in the short term. These projects will utilize available flow and sediment resources to expand and stabilize the existing wetlands in the delta prior to the onset of its retreat. In addition, a coordinated program of dredged material disposal, both from maintenance and dedicated dredging projects, will help to establish a line of barrier development throughout the existing delta. The major strategic points of the selected strategy are presented in Figure MR-2.

The concept of a major sediment diversion has been previously investigated at a reconnaissance level in the Louisiana Coastal Area, Mississippi River Delta Study completed by the U. S. Army Corps of Engineers, New Orleans District, in February 1990. This information should provide the basis for the next study level, a detailed feasibility study.

The significance of the available resources and the present lack of net delta growth is magnified in view of the extent of the larger wetlands loss problem in coastal Louisiana. This is apparent in a present day context and historically as well. In consideration of this fact, the selected strategy adopts an aggressive approach that would initiate the growth of a new delta. The basis for this selection is that the resource available in the Mississippi River cannot be under-utilized in the rebuilding and maintaining of the Louisiana coast. To achieve the goal of maintaining the current level of wetland functions and offset the high rates of wetland loss, measures which net large gains in coastal wetlands must be pursued. With this alternative, the transition from a posture of status quo to one of aggressive rebuilding is achievable.

COSTS AND BENEFITS

The benefits for the major project in this plan, the Uncontrolled Mississippi River Diversion, will be accrued in some other coastal basin. For the purpose of comparison with short-term projects (20 years), the cost and benefits of this project are estimated to be $428,720,000 and 61,290 acres. The project costs $910,000,000 and creates 89,300 acres over 50 years. Once constructed this project will continue to function well beyond 50 years, resulting in additional benefits and requiring continued maintenance. These benefits represent a significant reduction of wetlands loss from a coastal standpoint; however, they cannot be applied directly to the prevention of wetlands loss in this basin.

The direct costs and benefits of the selected plan in this basin are $23,910,000 and 24,600 acres, respectively. Based on these benefits, implementation of the selected plan will eliminate all projected loss and produce a net gain of 3,160 acres of wetlands over 20 years. The specific costs and benefits for known projects can be found in Table MR-2, which includes all projects in the selected plan.

The costs and benefits for the selected plan include only those projects with established designs. These include the long and short-term critical projects and all short-term supporting projects with the exception of any vegetative planting projects. Costs and benefits are shown for the long-term Bohemia Sediment Diversion project; however, this project would serve as a precursor or alternative to the critical Uncontrolled Mississippi River Diversion project. Because of this overlap, the costs and benefits of the larger, more crucial project have been included in the totals. Additional costs and benefits may be forthcoming as the details of additional supporting projects become known.

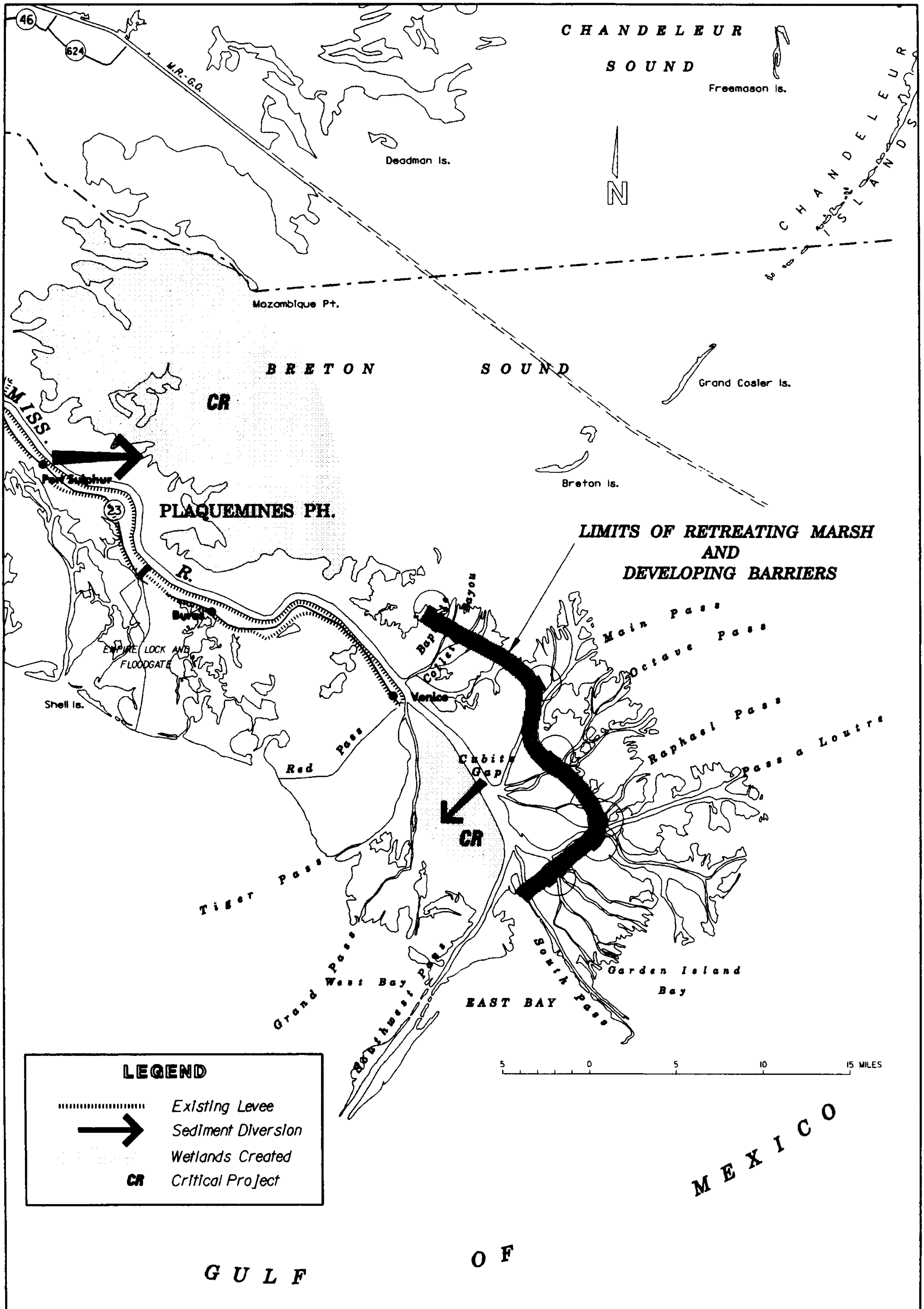


Figure MR-2. Mississippi River Delta Basin, Strategy Map.

Table MR-2
Summary of the Mississippi River Delta Basin Projects

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored or Protected	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acre ($/Ac)	Comments
Critical Projects, Short-Term								
FMR-3	West Bay Large Scale Sediment Diversion	SD	PPL1	9,831	10,722	6,328,000	600	
Critical Projects, Long-Term								
PMR-6	Mississippi River Channel Relocation	SD		89,300	89,300 *	910,000,000	10,200	50 Year Cost
				61,290	61,290	428,720,000	7,000	20 Year Cost
Supporting Projects, Short-Term								
MR-2	Pass A Loutre Sediment Fencing	ST		1,500	1,817	2,666,000	1,500	
FMR-4	Tiger Pass Dredged Material	MC		415	457	4,434,000	9,700	Deferred from PPL 1
PMR-5	Benny's Bay Sediment Diversion	SD		10,761	12,125	6,328,000	500	
PMR-8	Pass A Loutre Sediment Mining	MC		118	252	1,247,000	4,900	Deferred from PPL 2
PMR-8/9a	Pass a Loutre Crevasse	SD	PPL3	1,043	1,287	2,242,000	1,700	
XMR-10	Main Channel Armour Gaps	SD	PPL3	936	1,219	665,000	500	
XMR-11	Vegetative Plantings	VP						
Subtotal Supporting Projects, Short-Term				14,770	17,160	17,582,000		
Supporting Projects, Long-Term								
PMR-7	Mississippi River Passes Flow Redistribution	HR						
XMR-12	Beneficial Use of Hopper Dredge Material	MC						
XMR-13	Bohemia Sediment Diversion	SD		3,350	3,350 *	3,118,000	900	
XMR-14	Mississippi River Dredged Material Disposal Plan	MC						
Total Mississippi River Delta Basin **				24,600	27,880	23,910,000		
Total Mississippi River Delta Basin ***				85,890	89,170	452,630,000		

HR	Hydrologic Restoration	SD	Sediment Diversion	ST	Sediment/Nutrient Trapping
MC	Marsh Creation w/Dredged Material	SP	Shoreline Protection	VP	Vegetative Plantings

Net Benefitted Acres include aquatic vegetation & enhanced wetlands

* Denotes benefits not varified by the Wetland Value Assessment Work Group.

** Total includes only Short-Term Critical and Short-Term Supportin Projects.

*** Total includes Short-Term Supporting, Short-Term Critical, and Long-Term Critical (20 year) Projects.

KEY ISSUES

In the development of major strategies for this basin, measures to accommodate deep-draft navigation access between the Mississippi River and the Gulf of Mexico were of major concern. With a significant portion of national commerce dependent upon this deep-draft navigation route, it is essential that access between the river and the gulf be maintained without significant disruption. Any major reduction in the flow of the Mississippi River will result in a reduction of the naturally maintained channel. This would in turn result in increased dredging requirements.

Other important areas of impact exist under Strategy One. One would be the deterioration and retreat of the existing delta. The presence of the Delta National Wildlife Refuge and the Pass a Loutre Wildlife Management Area in the existing delta makes this an area of major concern for both State and Federal wildlife and fisheries authorities. Achieving a smooth transition, and a long-term net gain in acreage, from one delta area to the other is a specific concern and requires verification. The effects of the diversion in the receiving area also require study and verification. In Breton Sound, for example, a large number of oyster grounds and the Breton National Wildlife Refuge at its gulfward extent would be affected by the influx of fresh water.

Beyond these concerns a key issue to be addressed in this basin has ramifications for all of coastal Louisiana; a change in the basic philosophy for the selection and execution of environmental projects is needed. The Mississippi River, as the fifth largest drainage on earth, provides a resource of a global proportion. With a sediment output of millions of tons annually, the Mississippi River is responsible for the geology of the Louisiana coastal zone from Vermilion Bay to the Mississippi Sound. The present day utilization of this resource exhibits the manner in which the management of a significant resource to support one set of goals may lead to critical deficiencies and needs in meeting alternative goals.

Significant impacts to wetlands can be traced to existing projects intended for the protection or enhancement of long-term economic investment, both private and public. The decision to invest public funds in these projects has historically been based on the ability of the project to provide a positive level of benefit, measured in economic terms, within a relatively short project life span, traditionally 50 years. The cycles associated with natural processes and the life spans of the geologic and environmental features they produce are quite often much larger. An adjustment must be made in this basic analytic philosophy in order to select and execute environmental projects and to undertake the large measures necessary to overcome present wetland trends.

The perceived disparity between the initially analyzed, and the actual long-term, effects of existing water resources projects emphasizes the need to re-establish the essence of historically occurring natural processes. To accomplish this, a more foresighted philosophy for the recommendation, development, and execution of environmentally oriented projects is needed. Simply stated, the philosophy for successfully undertaking environmental restoration is to look beyond traditional short-term analyses of costs and benefits. The true benefits of these restoration efforts lie well beyond their immediate effects, in the long-term gains which ultimately provide the equilibrium necessary for the long-term conservation of coastal Louisiana.

BARATARIA BASIN: SUMMARY OF BASIN PLAN

STUDY AREA

The Barataria Basin (Figure BA-1) is located immediately south and west of New Orleans, Louisiana. The basin is bounded on the north and east by the Mississippi River from Donaldsonville to Venice, on the south by the Gulf of Mexico, and on the west by Bayou Lafourche. The basin contains approximately 1,565,000 acres. Portions of nine parishes are found in the basin: Assumption, Ascension, St. James, Lafourche, St. John the Baptist, St. Charles, Jefferson, Plaquemines, and Orleans. The basin is divided into nine subbasins: Fastlands, Des Allemands, Salvador, Central Marsh, Grande Cheniere, L'Ours, North Bay, Bay, and Empire.

EXISTING CONDITIONS AND PROBLEMS

The Barataria Basin is an irregularly shaped area bounded on each side by a distributary ridge formed by the present and a former channel of the Mississippi River. A chain of barrier islands separates the basin from the Gulf of Mexico. In the northern half of the basin, which is segregated by the Gulf Intracoastal Waterway (GIWW), several large lakes occupy the sump position approximately half-way between the ridges. The southern half of the basin consists of tidally influenced marshes connected to a large bay system behind the barrier islands. The basin contains 152,120 acres of swamp, 173,320 acres of fresh marsh, 59,490 acres of intermediate marsh, 102,720 acres of brackish marsh, and 133,600 acres of saline marsh.

Within the Barataria Basin, wetland loss rates averaged nearly 5,700 acres per year between 1974 and 1990. During this period, the highest rates of loss occurred in the Grande Cheniere and Bay Regions. Wetland loss within the Barataria Basin is attributed to the combination of natural erosional processes of sea-level rise, subsidence, winds, tides, currents, and herbivory, and the human activities of channelization, levee construction, and development.

Freshwater and sediment input to the Barataria Basin was virtually eliminated by the erection of flood protection levees along the Mississippi River and the closure of Bayou Lafourche at Donaldsonville; therefore, the only significant source of fresh water for the basin is rainfall. Only a small amount of riverine input, designed to mimic a natural crevasse, is introduced into the basin's wetlands through the recently completed siphons at Naomi and West Pointe a la Hache. This lack of fresh water, and the loss of the accompanying sediments, nutrients, and hydrologic influence, forms the most critical problem of the Barataria Basin.

The second critical problem is the erosion of the barrier island chain. As individual islands are reshaped or breached, or succumb to the forces of the Gulf of Mexico, passes widen and deepen with the result that a greater volume of water is exchanged during each tide.

Four islands--West Grand Terre, East Grand Terre, Grand Pierre, and Cheniere Ronquille--had a combined area of just over 1,800 acres in 1990. By 2015, the islands will be reduced to a total of approximately 1,000 acres. East Grand Terre and Grand Pierre are predicted to disappear by 2045, and the remaining islands will consist of only 400 acres.

The result of the problems described above is an increase in tidal amplitude in the marshes in the central basin. This cumulative effect is exemplified by increased salinities in the lower half of the basin, increased land loss rates, and change in vegetation.

Site-specific problems of shoreline erosion, especially in areas with organic soils, poor drainage, salinity stress, and herbivory, are apparent throughout the basin. Solving these problems is important, but less urgent than solving the critical problems described above.

FUTURE WITHOUT-PROJECT CONDITIONS

Projected wetland loss over the next 20 and 50 years within Barataria Basin, by the subbasins, is shown in Table BA-1. Without actions to correct the problems mentioned above, another fifth of the basin's wetlands would be lost to open water by 2045. Roughly 65 percent of the projected wetland loss, or more than 100,000 acres, would occur in the North Bay, L'Ours, Bay, and Empire subbasins. As wetlands bordering Barataria Bay erode and as its connection with the gulf becomes substantially larger because of the disappearance of the barrier islands, the bay would enlarge, absorbing adjacent waterbodies. With no action, moderate wetland losses (about 20 percent) would occur in the middle of the basin (Central Marsh and Salvador subbasins), and relatively minor losses (about 8 percent) would occur in the upper basin (Des Allemands) over the next 50 years. The disappearance of wetlands throughout Barataria Basin would mean the loss of critical breeding, nesting, nursery, foraging, or overwintering habitat for economically important fish, shellfish, furbearers, migratory waterfowl, alligator, and several endangered species. Loss of wetland habitat and the accompanying trend toward higher salinities would lead to lower biodiversity and productivity.

Table BA-1
Projected Marsh Loss in the Barataria Basin.

	Projected Loss in 20 years		Projected Loss in 50 years	
Subbasin	(Acres)	(Percent)	(Acres)	(Percent)
Des Allemands	1,010	3	2,520	7
Salvador	4,610	4	11,540	11
Central	7,380	10	18,440	26
L'Ours	6,240	21	15,590	53
North Bay	10,160	12	25,390	31
Grand Chenier	6,510	44	14,660	100
Empire	17,460	58	30,110	100
Bay	22,790	28	56,980	70
Total	76,160	17	175,230	38

Projected losses are based on Geographic Information System data compiled by the U.S. Army Corps of Engineers. Loss rates also are based on a projection of the 1974 to 1990 rates.

The disappearance of wetlands and the wildlife and fishery resources dependent on them would affect the economic structure of numerous communities in the lower and middle basin areas as supporting businesses (marinas, boat manufacturers, seafood processors, retailers, etc.) decline. In addition, the storm

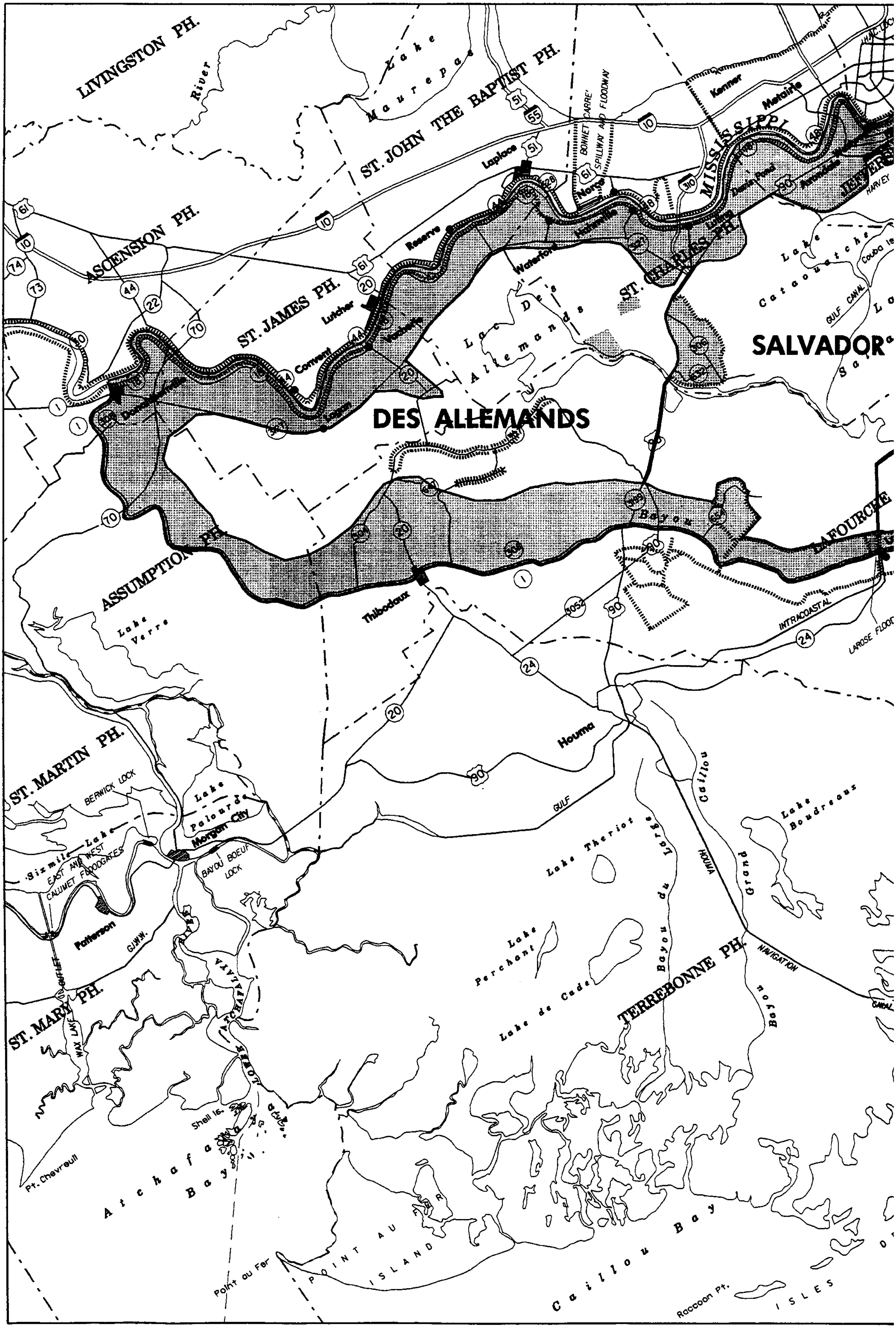
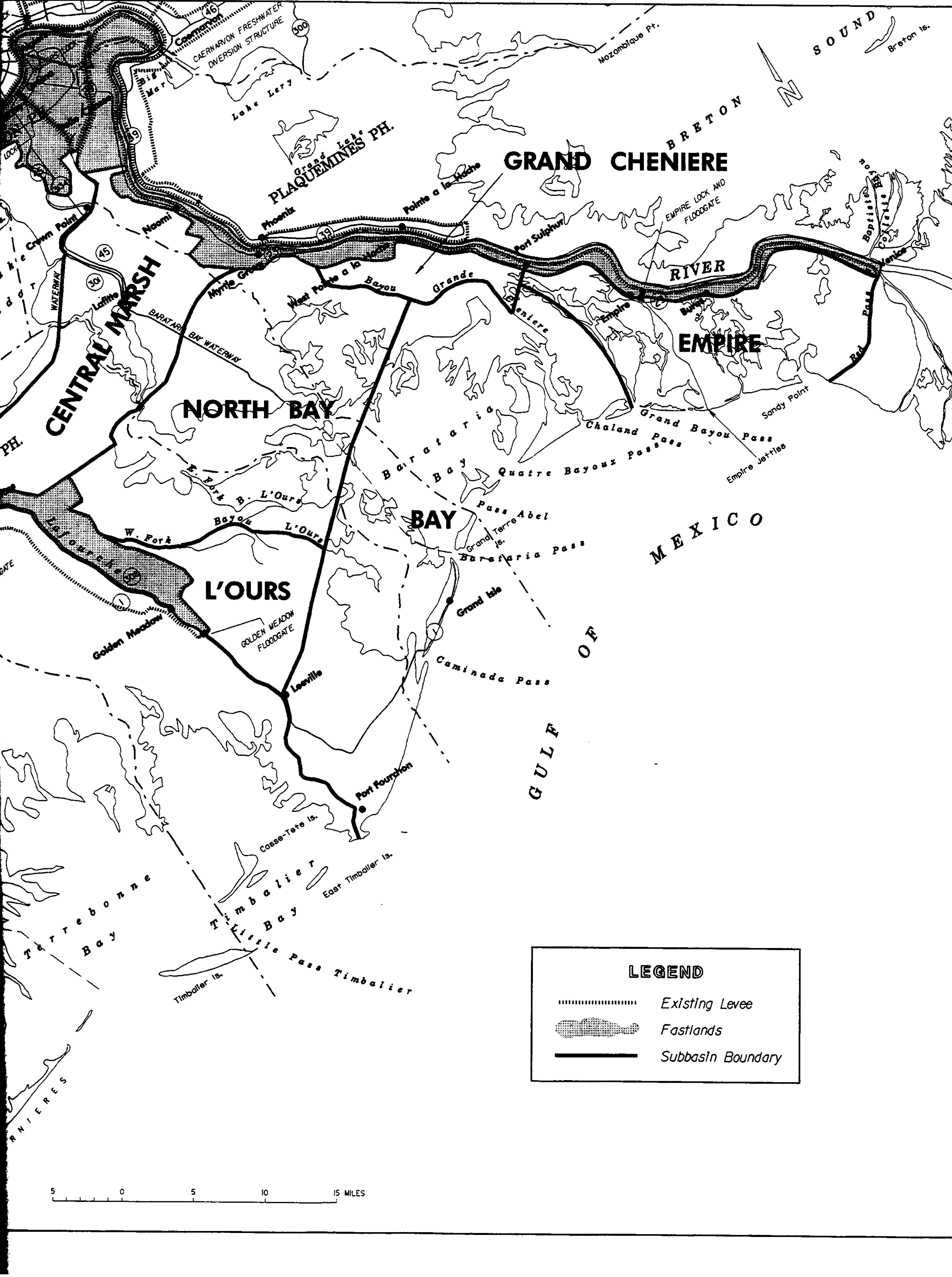


Figure BA-I. Barataria Basin, Basin and Subbasin Boundaries.


GRAND CHENIERE
CENTRAL MARSH
NORTH BAY
BAY
L'OURS
EMPIRE
PLAQUEMINES PH.
CAERNARVON FRESHWATER DIVERSION STRUCTURE
Caernarvon
Lake Lery
Grand Lake
Mozambique Pt.
BRETON SOUND
Breton Is.
Pointe a la Hache
Phoenix
Naomi
Myrtle Grove
West Pointe a la Hache
Port Sulphur
Bayou Grande
Cheniere
EMPIRE LOCK AND FLOODGATE
RIVER
Empire
Buras
Venice
Baptiste Collette
Red Pass
Sandy Point
Grand Bayou Pass
Chaland Pass
Quatre Bayoux Pass
Empire Jetties
Barataria Bay
Pass Abel
Grand Terre Is.
Barataria Pass
GULF OF MEXICO
Lafitte
BARATARIA BAY WATERWAY
WATERWAY
E. Fork B. L'Ours
W. Fork Bayou L'Ours
Lafourche
Golden Meadow
GOLDEN MEADOW FLOODGATE
Leeville
Grand Isle
Caminada Pass
Port Fourchon
Cosse-Tete Is.
East Timbalier Is.
Timbalier Bay
Terrebonne Bay
Little Pass Timbalier
Timbalier Is.
LEGEND
Existing Levee
Fastlands
Subbasin Boundary
5 0 5 10 15 MILES

buffering benefits the barrier islands and lower basin wetlands provide these communities, would be reduced as wetland loss continues. This loss would force relocations or require the expansion of flood protection and drainage facilities for many basin communities, and maintenance costs would increase for existing facilities.

BASIN PLAN

The selected plan focuses on the key strategies of freshwater and sediment diversion, combined with outfall and hydrologic management to reduce tidal exchange. Two additional mutually exclusive strategies were considered to offset the increase in tidal amplitude: sediment replenishment of the existing barrier islands or construction of a set of interior barrier islands. The former has been included in the selected plan because it supports the natural system, and would maintain the marshes located between the proposed interior barrier and the existing barrier islands. Supporting strategies of marsh creation with dredged material and shoreline protection address localized areas of marsh loss. A detailed description of the plan formulation process is contained in Appendix D. Strategies of the selected basin plan are shown in Figure BA-2, and projects are listed in Table BA-2.

Restoration of riverine input into the basin via freshwater diversion from the Mississippi River through the authorized Davis Pond Freshwater Diversion project helps in solving the first critical problem of freshwater and sediment deprivation. This diversion is vital to the health of the upper part of the basin because fresh water and nutrients slow the loss of marsh and swamp. Additional diversions from the Mississippi River on the eastern side of the basin, and the reconnection of Bayou Lafourche and subsequent construction of small diversions on the western side, are long-term solutions to the first critical problem. However, a study of the sediment and water budget for the Mississippi River must be completed first.

Sediment replenishment and marsh creation on the bay side of the barrier islands will strengthen the buffering capabilities of the barrier chain. Longshore sediment drift studies will determine the efficacy of installing segmented breakwaters or jetties to trap sediments that are, at present, transported from the system. Studies are planned on methods to reduce the cost of construction and to better evaluate the benefits of barrier islands to interior marshes. However, sediment replenishment of critical barrier islands (located adjacent to major tidal passes) needs to be implemented in the short term.

Hydrologic management to decrease tidal flux through the critical area of the central marshes and L'Ours Ridge will preserve the marshes in this area and slow the inland progression of the marine influence. Methods to reduce marsh loss rates and shoreline erosion, while providing access to the estuarine-dependent marine organisms so important to the economy of this basin, should be developed and implemented as soon as possible.

Several site-specific areas of loss are scattered throughout the basin. Small-scale measures to preserve, restore, and enhance these marshes and swamps are important. Implementation of these projects will maintain these areas until the critical long-term projects are in place.

The selected plan uses a mix of measures to achieve short-term basin objectives. Hydrologic restoration (77 percent), outfall management (8 percent), and barrier island nourishment (6 percent) account for the majority of the acres preserved, created, or enhanced. Marsh creation with dredged material, shoreline protection, and marsh management complete the short-term restoration process. The long-term portion of the plan, necessary to achieve no net loss of wetlands, consists of additional freshwater and sediment diversions, and continued barrier island replenishment.

COSTS AND BENEFITS

Table BA-3 summarizes the wetland benefits and costs over the next 20 years for the short-term projects proposed in the Barataria Basin selected plan and for the Davis Pond Freshwater Diversion project. The Davis Pond Freshwater Diversion project will preserve 83,000 acres over 50 years at a cost of $68.8 million. However, to be comparable to the CWPPRA projects, benefits and costs for 20 years (32,220 acres and $26,696,000) were used.

In the Des Allemands Subbasin, no direct benefits are achieved because there are no selected plan short-term projects and Davis Pond Freshwater Diversion is located south of the subbasin. However, this area will indirectly benefit from plan implementation because significant portions of the seaward subbasins will be restored or maintained, thus providing a continued barrier to the inland progression of marine influence.

Implementation of the short-term projects in the Salvador Subbasin would prevent 28 percent of the predicted loss. In the Central Marsh Subbasin, implementation of already funded projects BA-2, PBA-35, and XBA-65A, plus the deferred project BA-6, would result in predicted marsh enhancement of 177 percent. When estimated Davis Pond Freshwater Diversion benefits are added to the Salvador and Central Marsh Subbasins, marsh enhancement increases to 337 and 281 percent, respectively. The CWPPRA costs are $39,889,000.

Plan implementation would prevent 12, 13 and 55 percent of the predicted loss in the L'Ours, North Bay and Grande Cheniere Subbasins. The projects located in this mid-basin area are designed to protect wetlands against tidal and erosive forces. Adding the Davis Pond Freshwater Diversion benefits to the North Bay Subbasin prevents 75 percent of the predicted loss. The CWPPRA costs for this area are $8,344,000.

The lower basin marshes and barrier islands which make up the Empire and Bay Subbasins are projected to undergo the greatest losses. Plan implementation would only reduce the losses in these areas by 5 and 8 percent, respectively. The Davis Pond Freshwater Diversion project would prevent the loss of an additional 17 percent of wetlands in the Bay Subbasin. The CWPPRA costs are $66,425,000.

For a total expenditure of $114,658,000 on the selected plan projects, 23,050 acres of wetlands will be created, restored or protected. Over the next 20 years, 30 percent of predicted loss in the entire Barataria Basin would be prevented. Benefits from the Davis Pond Freshwater Diversion project increases the predicted amount of marsh saved to 73 percent, including gains in two subbasins.

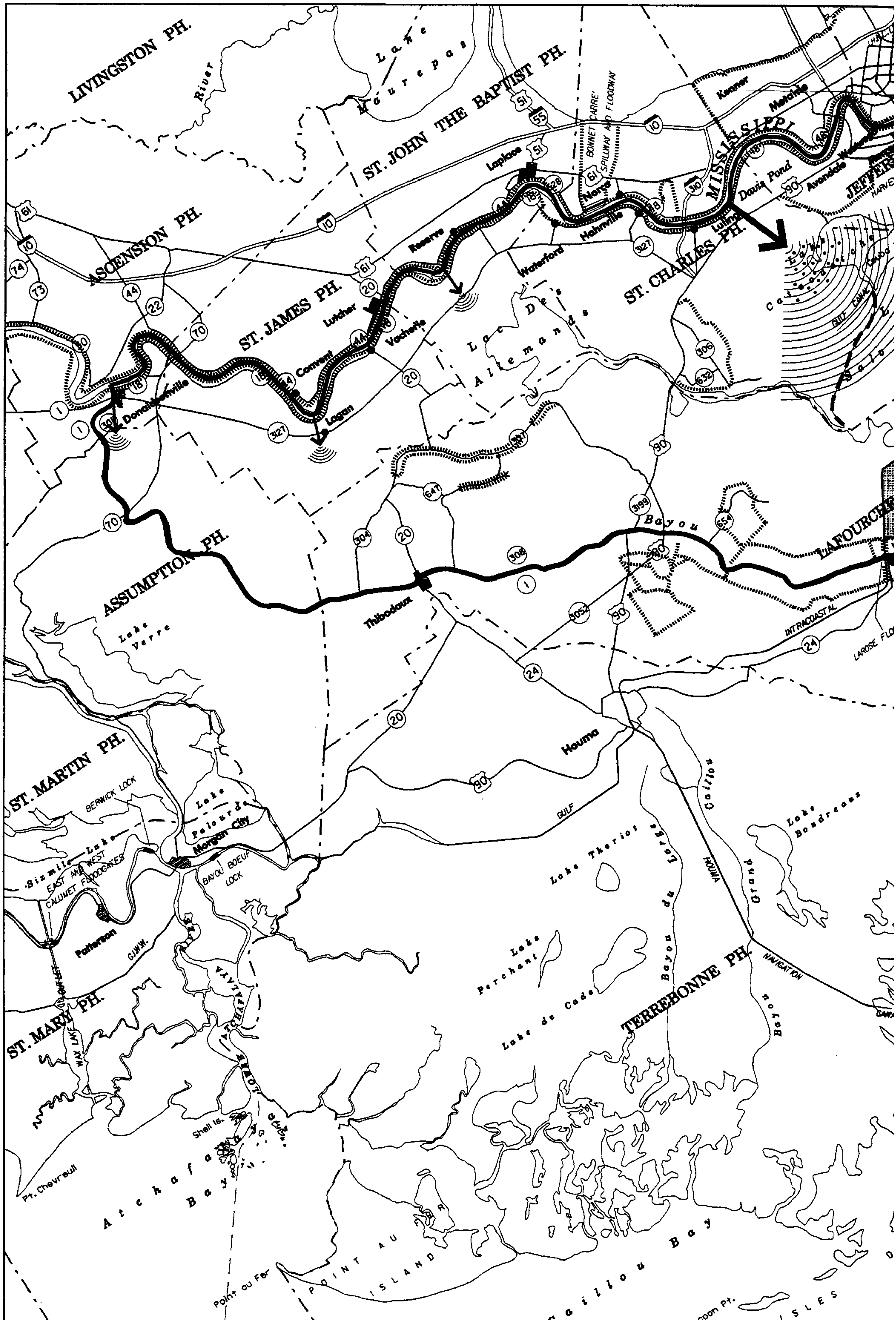


Figure BA-2. Barataria Basin, Strategy Map.

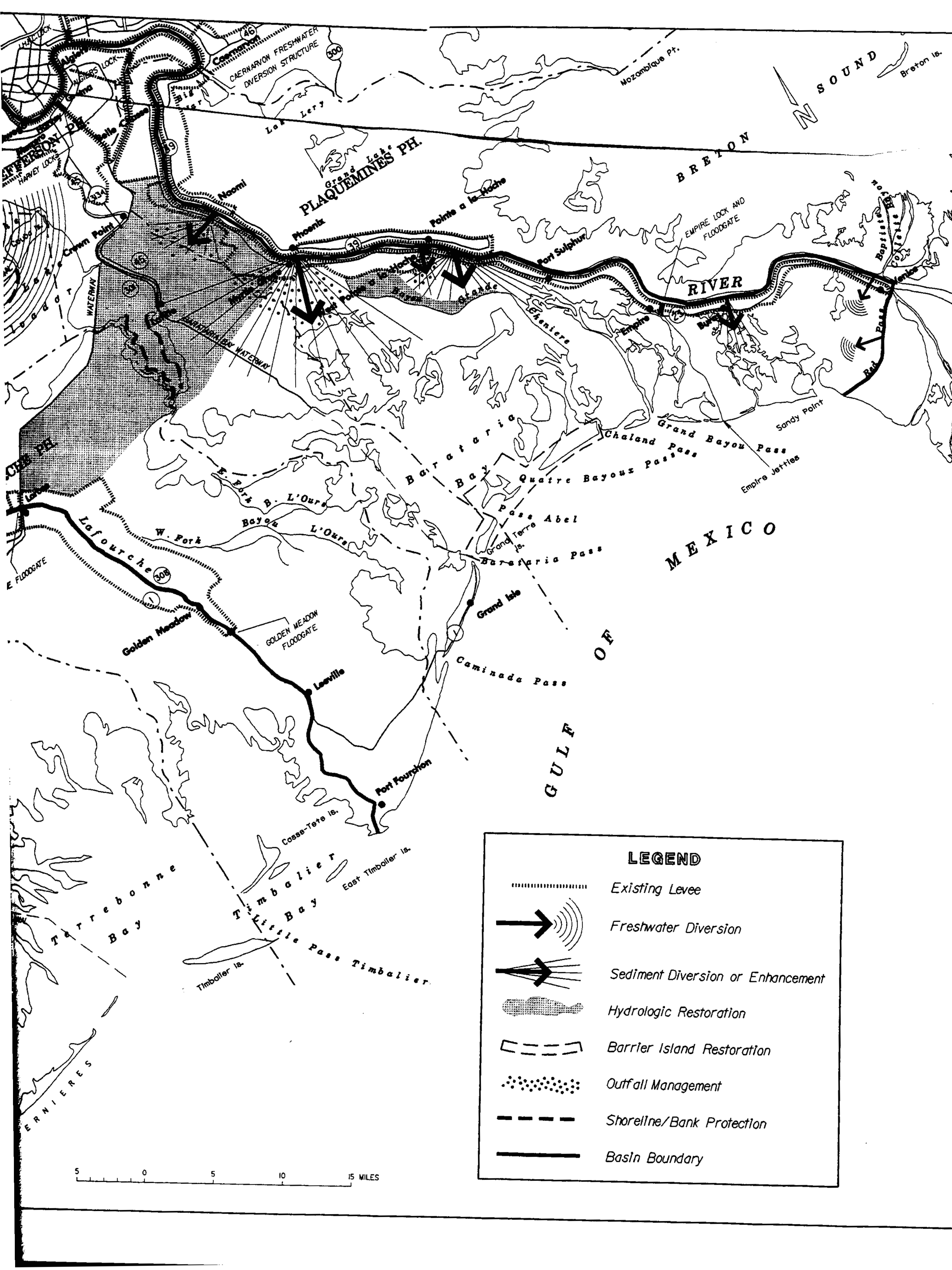

CAERNARVON FRESHWATER DIVERSION STRUCTURE
Caernarvon
Algiers
ALGIERS LOCK
HARVEY LOCKS
Belle Chasse
Big Mar
Lake Lery
Grand Lake
Mozambique Pt.
Breton Is.
BRETON SOUND
PLAQUEMINES PH.
Naomi
Phoenix
Pointe a la Hache
Port Sulphur
EMPIRE LOCK AND FLOODGATE
Empire
Buras
RIVER
Venice
Baptiste Collette
Red Pass
Sandy Point
Empire Jetties
Grand Bayou Pass
Chaland Pass
Quatre Bayoux Pass
Pass Abel
Grand Terre Is.
Barataria Pass
Barataria Bay
Bayou Grande
Cheniere
Crown Point
Lafitte
E. Fork B. L'Ours
W. Fork Bayou L'Ours
Lafourche
Larose
GOLDEN MEADOW FLOODGATE
Golden Meadow
Leeville
Grand Isle
Caminada Pass
Port Fourchon
Casse-Tete Is.
East Timbalier Is.
Timbalier Is.
Timbalier Bay
Terrebonne Bay
Little Pass Timbalier
GULF OF MEXICO
LEGEND
Existing Levee
Freshwater Diversion
Sediment Diversion or Enhancement
Hydrologic Restoration
Barrier Island Restoration
Outfall Management
Shoreline/Bank Protection
Basin Boundary
5 0 5 10 15 MILES

Table BA-2

Summary of the Barataria Basin Projects

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acre ($/Ac)	Comments
Critical Projects, Short-Term								
BA-1a	Davis Pond Freshwater Diversion	FD	•	32,220	32,220	26,696,000	800	Authorized USACE project (20 yr cost & benefits)
BA-3c	Naomi (La Reussite) Diversion Outfall Management	OM		840	1,640	1,428,000	900	
BA-4c	West Pointe a la Hache Diversion Outfall Management	OM	PPL3	1,090	2,450	677,000	300	
XBA-1a	West Grand Terre Sediment Replenishment	BI		440	450	7,934,000	17,600	
XBA-1b	East Grand Terre Sediment Replenishment	BI		380	400	7,441,000	18,600	
XBA-1c	Grand Pierre Island Sediment Replenishment	BI		80	180	3,300,000	18,300	See XBA-53
XBA-1d	Cheniere Ronquille Sediment Replenishment	BI		180	190	2,368,000	12,500	
XBA-54	Bayou Grande Cheniere Subbasin Hydrological Restoration	HR		2,480	7,750	1,344,000	200	
Subtotal: Critical Projects, Short-Term				5,490	13,060	24,492,000		Costs & benefits do not include Davis Pond
Critical Projects, Long-Term								
BA-1b	Davis Pond Diversion Outfall Management, Phase 1	OM						Implement after diversion construction
BA-3b	Naomi (La Reussite) Diversion Siphon Enlargement	FD						On hold
BA-4b	West Pointe a la Hache Diversion Siphon Enlargement	FD						On hold
BA-10	Davis Pond Diversion Outfall Management, Phase II	OM		580	1,610	6,525,000	4,100	
BA-11	Tiger/Red Pass Diversion and Outfall Management	OM		800	1,360	5,321,000	3,900	
BA-12	Grand/Spanish Pass Diversion	FD						
BA-13	Hero Canal Freshwater Diversion	FD		350	350	9,510,000	27,200	
BA-17a	City Price Freshwater Diversion (Happy Jack)	FD		50	150	1,806,000	12,000	Probably will be two diversions
BA-17b	City Price Freshwater Diversion (Homeplace)	FD		1,130	1,270	3,094,000	2,400	Probably will be two diversions
PBA-18	Sediment Diversion at Hero Canal	SD						Supports BA-13
PBA-20	Freshwater Diversion to Bayou Lafourche	FD			300,000	1,500,000,000	5,000	
PBA-21	Route Diversion Outfalls to Area N. of The Pen	OM						
PBA-32	Hydrologic Restoration of Marshes Southeast of Leeville	HR						
PBA-36	Lagan Diversion	FD						
PBA-37	Bayou Des Allemands Diversion	FD						
PBA-44	Sediment Diversion at Buras	SD						
PBA-48a	Myrtle Grove Sediment Diversion Facility	SD						
PBA-48b	Myrtle Grove Outfall Management, Areas 1 thru 5	OM						
XBA-63	Central Basin Tidal Drag Enhancement	HR		24,130	74,470	16,782,000	200	
XBA-67b	Siphoned Sediment Enrichment of Davis Pond Diversion	SD						
XBA-67c	Siphoned Sediment Enrichment of Naomi Diversion	SD						
XBA-67d	Siphoned Sediment Enrichment of W Pointe a la Hache Diversion	SD						

Table BA-2

Summary of the Barataria Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acre ($/Ac)	Comments
Supporting Projects, Short-Term								
BA-2	GIWW to Clovelly Hydrologic Restoration	HR	PPL 1	8,630	16,980	6,285,000	400	Permitted, active
BA-6	U.S. Highway 90 to GIWW Hydrologic Restoration	HR		1,620	6,360	4,583,000	700	Deferred from PPL 1
BA-7	Couba Island Shoreline Protection	SP		250	300	752,000	2,500	
BA-8	Lake Cataouatche Shoreline Protection	SP		20	70	376,000	5,400	
BA-9	Salvador WMA Gulf Canal Shoreline Protection	SP		40	60	844,000	12,060	
BA-14	Little Lake Marsh Management	MM		270	670	1,112,000	1,700	
BA-16	Bayou Segnette Wetland Protection	HR		90	90	1,106,000	12,300	
BA-18	Fourchon Wetland Restoration	HM	PPL 1	160	380	187,000	500	Partially completed by port
BA-19	Barataria Bay Waterway Marsh Building	MC	PPL 1	450	470	1,125,000	2,400	
PBA-11	Shoreline Protection on Grand Bayou with Tire Breakwater	SP		10	10	576,000	57,600	
PBA-12	BBW Shoreline Protection Below Bayou Rigolettes	SP		140	190	1,762,000	9,300	
PBA-16	The Pen Shoreline Protection	SP		60	110	2,324,000	21,100	
PBA-34	Hydrologic Restoration of Bayou L'Ours Ridge	HR		780	2,780	2,327,000	800	
PBA-35	Jonathan Davis Wetland Restoration	HR	PPL 2	510	1,580	2,796,000	1,800	
PBA-38	Shell Island Sediment Replenishment	BI		** 510	640	22,060,000	34,500	Included in XBA-1e, river sediments, not in total
PBA-39	Sandy Point Barrier Island Sediment Replenishment	BI		600	620	17,264,000	27,800	River sediments
PBA-58	Little Lake Oil and Gas Field Canal Closures	HR		580	1,130	1,193,000	1,100	
PBA-60	Barataria Drainage Pump Outfall Management	OM		20	90	97,000	1,100	Part of PBA-35 and XBA-63
PBA-61	Southeast Lake Salvador Hydrologic Restoration	HR		690	1,660	10,690,000	6,400	
PBA-66	Bara Bar Channel Maintenance Disposal on West Grand Terre	BI		160	160	3,027,000	18,900	
XBA-1e	Shell Island to Empire Jetties Sediment Replenishment	BI		510	530	15,296,000	28,900	Overlaps PBA-38, bay sediments
XBA-1f	Bay Champagne Gulf Shore Sediment Replenishment	SP		290	290	1,798,000	6,200	
XBA-51	Marsh Creation in Canals Between Passes La Mer and Chaland	MC		230	260	7,800,000	30,000	
XBA-65a	Restore Perot Peninsula Marsh, Spray Dredge	MC	PPL 3	1,070	1,480	1,658,000	1,100	
XBA-70	Dupre Cut & Bayou Dupont Shoreline Protection	SP		200	710	3,930,000	5,500	
Subtotal: Supporting Projects, Short-Term				17,380	36,980	88,908,000		

Table BA-2

Summary of the Barataria Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acre ($/Ac)	Comments
Supporting Projects, Long-Term								
PBA-42	U.S. Highway 90 Drainage Improvements	HR						
PBA-45	Hydrologic Management of Grand Bayou	HR						
XBA-1a1	West Grand Terre Detached Breakwaters	SP			90	5,121,000	56,900	
XBA-1b1	East Grand Terre Detached Breakwaters	SP			600	4,481,000	7,500	
XBA-1c1	Grand Pierre Island Detached Breakwaters	SP			110	1,440,000	13,100	
XBA-1d1	Cheniere Ronquille Detached Breakwaters	SP			80	2,881,000	36,000	
XBA-1e1	Shell Island to Sandy Point Detached Breakwaters	SP			110	18,252,000	165,900	
XBA-49	Hydrologic Restoration of Marshes South of Clovelly	HR						
XBA-52	Grand Isle Jetty or Detached Breakwaters	BI						
XBA-53	Grand Pierre Jetty	BI		10	30	576,000	19,200	See XBA-1c
XBA-55	Jetty Modifications at Empire Waterway	SP		80	130	4,315,000	33,200	
XBA-56	Jetty Modifications at Belle Pass	SP		10	30	4,315,000	143,800	
XBA-62a	Northern Perot Peninsula Shoreline Protection	SP		480	480	9,367,000	19,500	
XBA-62b	Southern Perot Peninsula Shoreline Protection	SP		270	270	11,439,000	42,400	
Demonstration Projects								
BA-15	Lake Salvador Shoreline Protection	SP	PPL 3	180	1,190	1,258,000	1,100	
PBA-50	Oyster Reef Demonstration in Rambo Bay	SP		5	5	374,000	74,800	
XBA-50	Nairn Wetland Creation	MC		220	280	13,629,000	48,700	
XBA-67a	Dredged Sediment Enrichment of Davis Pond Diversion	SD						
Total Barataria Basin ***				23,050	51,230	114,658,000		
Total Barataria Basin with Davis Pond Freshwater Diversion ***				55,270	83,450	141,354,000		

BI Barrier Island Restoration
FD Freshwater Divesion
HM Hydrologic Managment of Impoundments
HR Hydrologic Restoration
MC Marsh Creation
MM Marsh Management
OM Outfall Management
SD Sediment Diversion
SP Shoreline or Bank Protection

* Cost and benefits for BA-1a, Davis Pond Freshwater Diversion, reflect a 20 year project life.

** Project PBA-38 overlaps with project XBA-1e, however, different construction techniques are used. PBA-38 is not included in the totals.

*** Total cost and benefits for the basin plan include only those for Critical Short-Term Projects and Supporting Short-Term Projects (BA-15 Demonstration included).

Table BA-3.
Estimated Benefits and Costs of Barataria Basin Selected Plan Projects

	CWPPRA			Davis Pond		Total	
Subbasin	Net Acres Protected, Created, or Restored	Cost x 1000 ($)	Percent Loss Prevented	Net Acres Protected, Created, or Restored	Cost x 1000 ($)	Net Acres Protected, Created, or Restored	Percent Loss Prevented
Des Allemands	0	0	0	0		0	0
Salvador	1,270	15,026	28	14,280		15,550	337
Central Marshes	13,090	24,863	177	7,640		20,730	281
L'Ours	780	2,327	12	0		780	12
North Bay	1,300	3,430	13	6,310		7,610	75
Grande Cheniere	3,580	2,587	55	0		3,580	55
Empire	1,110	32,560	5	0		1,110	7
Bay	1,920	33,865	8	3,990		5,910	23
Total	23,050	114,658	30	32,220	26,696	55,270	73

TERREBONNE BASIN: SUMMARY OF BASIN PLAN

STUDY AREA

The Terrebonne Basin is bordered by Bayou Lafourche on the east, the Atchafalaya Basin floodway on the west, and the Gulf of Mexico on the south. The Terrebonne Basin is divided into four subbasins--Timbalier, Penchant, Verret, and Fields, as shown in Figure TE-1. The basin includes all of Terrebonne Parish, and parts of Lafourche, Assumption, St. Martin, St. Mary, Iberville, and Ascension parishes.

EXISTING CONDITIONS AND PROBLEMS

The Terrebonne Basin is an abandoned delta complex, characterized by a thick section of unconsolidated sediments that are undergoing dewatering and compaction, contributing to high subsidence, and a network of old distributary ridges extending southward from Houma. The southern end of the basin is defined by a series of narrow, low-lying barrier islands (the Isles Dernieres and Timbalier chains), separated from the mainland marshes by a series of wide, shallow lakes and bays (e.g., Lake Pelto, Terrebonne Bay, Timbalier Bay).

The Verret and Penchant Subbasins receive fresh water from the Atchafalaya River and Bay, while the Fields Subbasin gets fresh water primarily from rainfall. The Timbalier Subbasin gets fresh water from rainfall and from Atchafalaya River inflow to the GIWW via the Houma Navigation Canal (HNC) and Grand Bayou Canal; it has the most limited fresh water resources in the entire Deltaic Plain.

The Terrebonne Basin supports about 155,000 acres of swamp and almost 574,000 acres of marsh, grading from fresh marsh inland to brackish and saline marsh near the bays and the gulf. The Verret Subbasin contains most of the cypress swamp (118,000 acres) in the Terrebonne Basin. The northern Penchant Subbasin supports extensive fresh marsh (about 166,000 acres), including a predominance of flotant marsh, with 98,000 acres of intermediate and brackish marsh in the Lost Lake-Jug Lake area and about 17,000 acres of saline marsh to the south. Fresh marsh is also dominant in the Fields Subbasin (approximately 23,000 acres). The Timbalier Subbasin grades from fresh marsh in the northern part of the subbasin to saline marsh near the bays, but is dominated by brackish (71,000 acres) and saline (153,000 acres) marsh types.

Of the four subbasins, only the Fields Subbasin experiences problems which are local and relatively minor. The Timbalier Subbasin experiences substantial subsidence and is essentially isolated from major freshwater and sediment inputs. Marsh loss rates are high due to the resulting sediment deficit, saltwater intrusion along the Houma Navigation Canal and other canals, historic oil and gas activity, and natural deterioration of barrier islands, which contributes to the inland invasion of marine tidal processes (including erosion, scour, and saltwater intrusion). The subbasin is rapidly converting to an open estuary.

In recent years, the Penchant and Verret Subbasins have experienced significant freshwater impacts from the Atchafalaya River. Historic wetlands loss resulting from subsidence, saltwater intrusion, and oil and gas activity appears to have moderated, but areas of cypress swamp (Verret) and flotant marsh (Penchant) are experiencing stress from high water levels in the Penchant Subbasin, the use of freshwater and sediment resources is not being maximized.

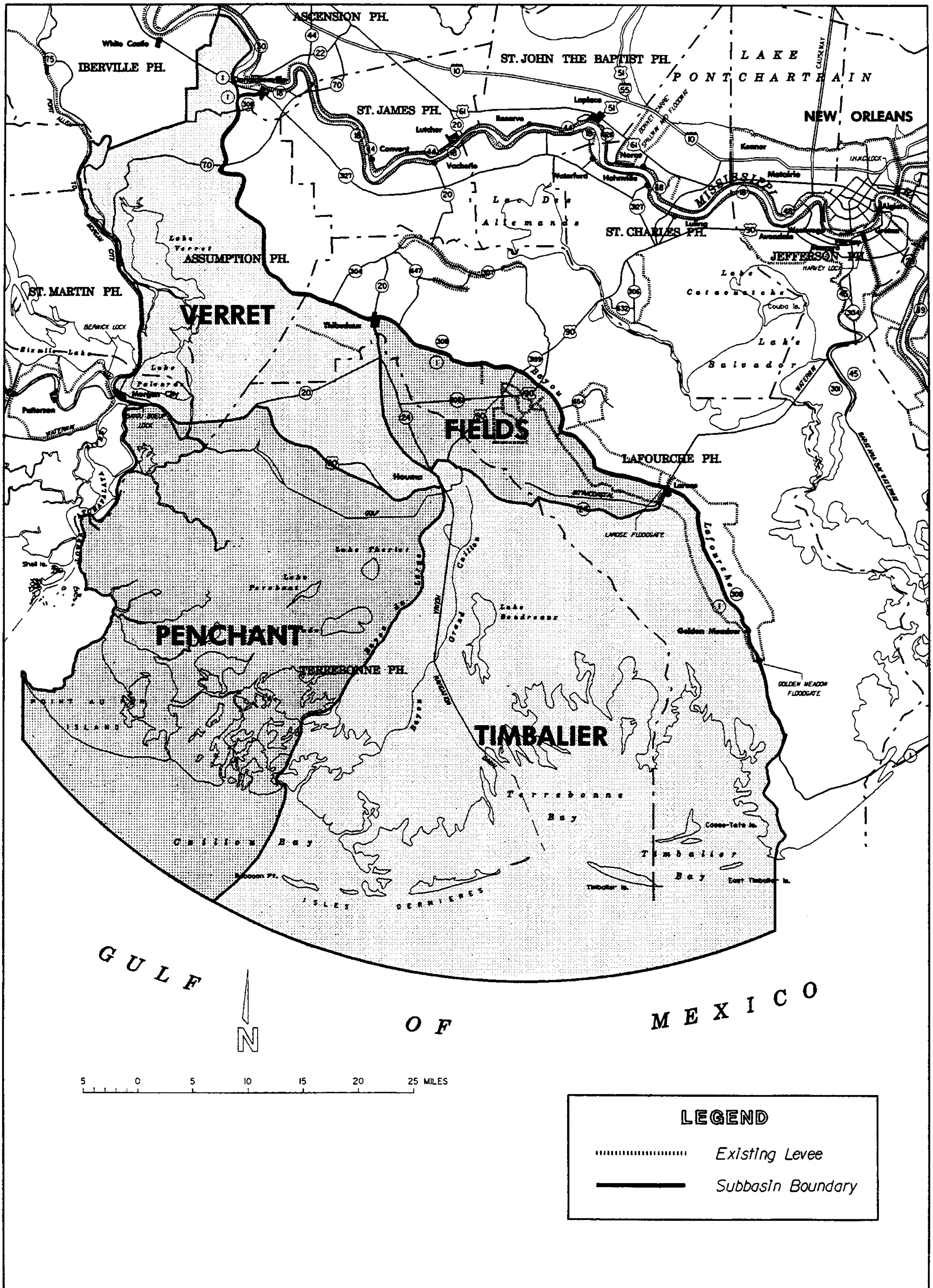


Figure TE-1. Terrebonne Basin, Basin and Subbasin Boundaries.

FUTURE WITHOUT-PROJECT CONDITIONS

Under a no action alternative, and assuming continued losses at the 1974-1990 rate, existing wetlands would be lost in the magnitude outlined in Table TE-1. The projected loss of more than half the Timbalier marshes in 50 years could be exceeded, because of the expectation that protection by existing barrier islands will cease within a few years to a few decades. The actual loss of Penchant marshes may be less than shown, because of benefits from Atchafalaya fresh water and sediment that have been increasing.

With no action, the Timbalier Subbasin will become 75 percent (or more) open water, with the shore reaching as far north as the suburbs of Houma. In the Penchant Subbasin, losses will likely be concentrated in the northern and central sectors, further exposing areas of open water and broken marsh. The inefficient use of Atchafalaya fresh water and sediments will continue to squander this significant resource. With continued high marsh losses, biological productivity and diversity will decrease. With loss of critical habitat for commercially and recreationally important fish, shellfish, and furbearers, as well as for endangered species, fish and wildlife dependent economic activities will decline. Flooding problems will increasingly impact economic activities throughout the Terrebonne Basin, leading to grave consequences for the oil and gas industry and for other human infrastructure.

Table TE-1.
Projected Marsh Loss

Subbasin	Projected Loss in 20 years (Acres)	(Percent)	Projected Loss in 50 years (Acres)	(Percent)
Timbalier	60,100	22	150,250	56
Penchant	24,900	8	62,250	20
Verret	Not Available		Not Available	
Fields	2,800	11	7,000	29
Total	87,800	14	219,500	36

BASIN PLAN

In the Timbalier Subbasin, protection and restoration of the barrier islands (Isles Dernieres and Timbalier Islands) requires immediate and extensive action, because these landforms provide protection for mainland marshes, and destruction of many of the islands is imminent. Interior marshes will also be protected through a hydrologic restoration zone which will be developed in the vicinity of the independently proposed Terrebonne Parish Comprehensive Hurricane Protection system. In this zone, fresh water and sediment will be used along with marsh protection and passive hydrologic restoration structures to enhance and restore overland and sinuous channel flow. A related action in the Timbalier Subbasin is a proposed barrier to saltwater intrusion in the Houma Navigation Canal.

In the Penchant Subbasin, Atchafalaya River fresh water, sediment, and nutrients will be better utilized through hydrologic restoration to protect marshes and reduce loss rates. To the extent possible, actions will restore historic flow

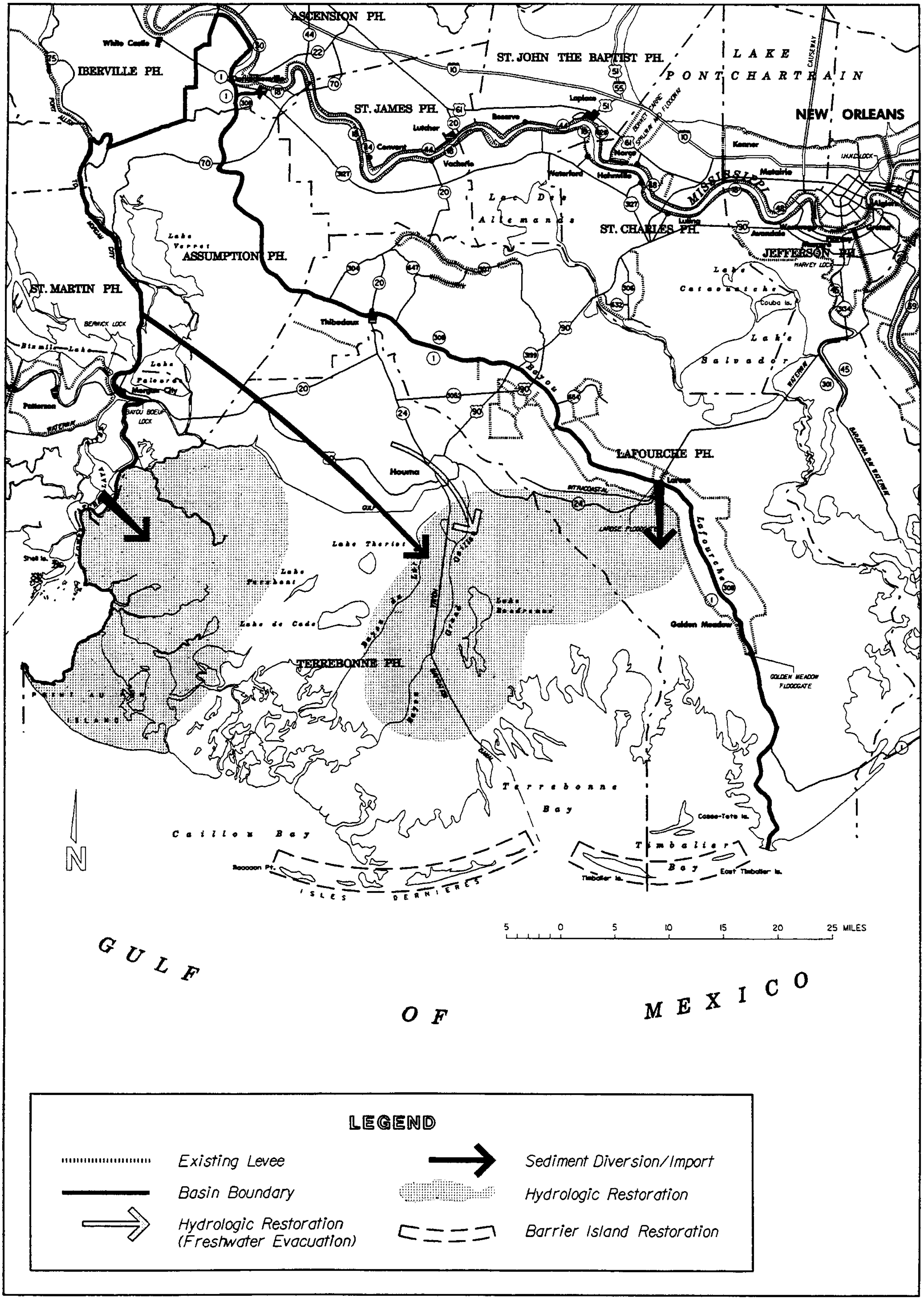


Figure TE-2. Terrebonne Basin, Strategy Map.

patterns and conveyance channels and improve the distribution of sediment-laden water. These actions in Timbalier and Penchant are considered critical for short-term implementation.

In the Penchant Subbasin, at least one major diversion would be built from the Atchafalaya River to bring fresh water and sediment into the subbasin. This is contingent upon adequate addressing of flood problems in the subbasin.

Because these actions will not cover all areas of concern, a supporting short-term strategy is to consider site-specific, small-scale projects in all subbasins where there is a critical need for wetlands protection or restoration, or a significant opportunity for wetlands creation. In the short term, demonstration and pilot projects must also be conducted to develop or test methods and approaches needed for implementing long-term strategies.

In the Timbalier Subbasin, long-term restoration depends on cost-effective importation of sediment by diversions or dedicated dredging, which makes demonstration of sediment extraction, transport, and placement technologies a priority. In addition, the possibility of diverting Mississippi River water and sediment into Bayou Lafourche as a conduit to the Timbalier Subbasin (as well as to the Barataria Basin) must be evaluated, and will be part of a larger study. The establishment of a Mississippi River sediment budget and distribution options, to be initiated by the Task Force immediately, will greatly aid in this effort.

In the Verret Subbasin, pumping to lower water levels is required to protect the swamp forests. This is a long-term strategy, because significant planning activities must precede its implementation. In addition, this action cannot occur until provisions are made for managing outfalls in ways which will not exacerbate flooding in the Penchant Subbasin.

In summary, the Terrebonne Basin Plan includes both a short-term and a long-term phase. The short-term phase focuses on immediate actions needed to protect vulnerable marshes from the proximal causes of loss in the Terrebonne Basin (saltwater intrusion, erosion, and other consequences of significant hydrologic modifications) using a combination of restoration techniques (especially hydrologic restoration and small-scale marsh creation) in the most critical areas or key locations, and barrier island protection. Successful implementation of short-term strategies will reduce rates of wetlands loss, and will provide the foundation for longer-term strategies. The long-term phase focuses on wetlands gains through sediment diversion and import, with the intent of encouraging development of a sustainable wetland ecosystem. Long-term strategies are critical to addressing the primary problem of sediment starvation associated with high subsidence and loss of fluvial inputs, and to achieving no net loss of wetlands in the basin.

Projects included in the Terrebonne Basin Plan are listed in Table TE-2. Table TE-2 indicates the classification (e.g., critical, supportive, demonstration), estimated benefits and costs, and status of these projects. The main elements of the Terrebonne Basin strategy are displayed in Figure TE-2.

A description of the Terrebonne Basin plan formulation process is contained in Appendix E. A complete listing of projects that have been proposed for the Terrebonne Basin can be found in Appendix E, Table 5, including those that were combined with other projects, or were not included in the plan for reasons stated in the appendix. More detailed information on each selected project also is provided in Appendix E.

Table TE-2
Summary of the Terrebonne Basin Projects

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acre ($/Ac)	Comments
Critical Projects, Short-Term								
Penchant Subbasin								
PTE-26	Upper Bayou Penchant	HR		[10,600]	[49,153]	50,000,000	1,000	
PTE-26b	Brady Canal Hydrologic Rest	HR	PPL 3	297	1,968	3,609,000	1,900	
PTE-23 /XTE-33	Lake Chapeau Hydr Rest/Sed	HR/MC	PPL 3	509	2,136	3,663,000	1,700	Includes XTE-33.
Subtotal				11,406	53,257	57,272,000		
Timbalier Subbasin, Barrier Island Restoration								
TE-11a	Is Derneriers New Cut Closures	BI		3	73	6,400,000	81,000	Complements PTE-15.
TE-20	Eastern Isles Dernieres	BI	PPL 1	9	79	5,714,000	72,300	
PTE-15	Restore Isles Dernieres	BI		1,050	1,864	33,188,000	17,800	Interacts w/ TE-20, XTE-41, XTE-45, XTE-40, XTE-67.
PTE-15b	Restore Is Dernieres Phase 2	BI						Interacts w/ TE-20,XTE-41, XTE-45, XTE-40, XTE-67.
PTE-15bi	Whiskey Island Restroration	BI	PPL 3	1,239	1,386	4,524,000	3,300	
PTE-15bii	Raccoon Island Restoration	BI						
XTE-41	Isles Dernieres Phase 1	BI	PPL 2	109	276	6,426,000	23,300	Cost & acreage included in PTE-15 for totals, active.
XTE-45	Timbalier Restoration	BI						
XTE-67	Creation/East Timbalier Island	BI	PPL 3	1,013	2,745	1,870,000	700 ✓	
Subtotal				3,423	6,423	58,122,000		
Timbalier Subbasin, Hydrologic Restoration								
TE-7a	Lake Boudreaux Watershed	MM/HR		63	796	2,665,000	3,300	2/
TE-7d	Lake Boudreaux Watershed	MM/HR		[1,492]	[5,888]	9,364,000	6,400	2/
TE-9	Bully Camp Marsh	MM		43	235	638,000	2,700	2/
TE-10/ XTE-49	Grand Bayou-GIWW Diversion Cutoff Canal Plug	FD/HR		[1,825]	[4,929]	5,515,000	1,100	2/, Interacts w/ XTE-47/48, XTE-49,51, See XTE-49.
TE-19	Lower B LaCache Wetlands	HR	PPL 1	86	292	1,388,000	4,800	2/, Active.
TE-21	Falgout Canal South	MC		104	118	5,792,000	49,000	3/, Interacts w/ XTE-43, XTE-55.
PTE-3	HNC Bank Stabilization	SP		311	1,059	1,600,000	1,500	
PTE-19	Stromwater Runoff Management	HR						2/
PTE-25	Bayou Blue water Management	HR		1,089	2,431	[4,400,000]	1,800	2/, Interacts w/ TE-10/XTE-49, TE-9, XTE-47/48.
XTE-29	Wonder Lake Restoration	MM		613	1,196	[2,200,000]	1,800	
XTE-35	HNC Sill							
XTE-42	HNC Lock	HR		2,891	2,891	122,545,000	42,400	Interacts w/ XTE-35.
XTE-47/48	Grand B Blue/Bully Camp Rest	MM/HR		247	1,829	[3,300,000]	1,800	2/
XTE-55	South Falgout Hydrologic Rest	HR		472	1,948	2,128,000	1,100	2/
XTE-56	South Bay Pelton Hydrologic Rest	HR		26	328	833,000	2,500	2/
XTE-57	South Pt au Chien Hydr Rest	HR		610	1,285	805,000	600	2/
XTE-58	South Bully Camp Hydr Rest	HR		1,401	3,109	1,879,000	600	2/
XTE-59	South Fina LaTerre Hydr Rest	HR		18	387	499,000	1,300	2/
XTE-60	South Wonder Lake Hydr Rest	HR		1,635	3,088	2,060,000	700	2/
Subtotal				12,926	31,809	167,611,000		
Subtotal Critical Projects, Short-Term				27,760	91,490	283,005,000		

Table TE-2
Summary of the Terrebonne Basin Projects (continued)

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acre ($/Ac)	Comments
Critical Projects, Long-Term								
Penchant Subbasin, Sediment Diversion								
PTE-5	Atchafalaya River Diversion	SD		[6,000]	[6000]			Interacts w/ PTE-13, PTE-26.
Timbalier Subbasin, Sediment Import from the Mississippi or Atchafalaya Rivers								
XTE-52	Miss R/B Lafouche Diversion	FD		[14,000]	[14,000]	[1,500,000,000]	107,100	Interacts w/ PTE-17.
XTE-63	Sediment Distribution/30" Pipe	SD						
Timbalier Subbasin, Sediment Import Dedicated Dredging								
XTE-44	Large Creat/Line of Defense (LOD)	MC		[86,311]	[86,311]			
Verret Subbasin, Hydrologic Restoration								
XTE-32	B Boeuf Pump Station/Barrier	HR						Interacts w/ XTE-50/51.
XTE-50	Verret Drainage of B Lafouche	HR/FD						4/, Interacts w/ XTE-32, XTE-51.
XTE-51	Disch Channel Verret-Houma	HR						4/, Interacts w/ XTE-32, XTE-50.
Supporting Projects, Short-Term								
Timbalier Subbasin								
TE-5	Grand Bayou Wetland	MM		823	7,043	2,500,000	400 ✓	1/, TE-5a mostly constructed.
TE-6	Point au Chien Wetland	MM		589	1,696	3,800,000	2,200	1/
TE-8	Bayou Pelton Wetland	MM		137	795	1,720,000	2,200	1/
TE-12	Bird Island Restoration	MC		10	15	2,117,000	141,100	
TE-17	Falgout Canal Vegetative Planting	VP	PPL 1	49	53	161,000	3,000	
TE-18	Timbalier Island Planting	VP	PPL 1	178	497	390,000	800	
PTE-27	W Belle Pass Headland Rest	MC/SP	PPL 2	474	639	4,424,000	6,900	
XTE-40	Timbalier Sediment Trapping	ST		4	93	1,359,000	14,600	Interacts w/ XTE-45.
XTE-62	Creation at Wine Island Shoals	BI		5	13	[500,000]	38,500	
Subtotal				2,269	10,844	16,971,000		
Penchant Subbasin								
PTE-22/24	Pt au Fer Canal Closure	HR	PPL 2	375	804	978,000	1,200	
XTE-38(d-i)	GIWW Bank Restoration	SP		130	684	3,800,000	5,600	
XTE-64	Avoca Island Sediment Div	SD		413	1,030	922,000	900 ✓	
XTE-65	Spray Dredging W Locust Bayou	MC		[1,300]	[1,300]	3,318,000	2,600	
Subtotal				2,248	3,978	9,018,000		
Fields Subbasin								
TE-16	St. Louis Wetlands Rest	MC		31	82	500,000	6,100	
XTE-38(a-c)	GIWW Bank Restoration	SP		30	160	315,000	2,000	
Subtotal				61	242	815,000		
Subtotal Supporting Projects, Short-Term				4,550	14,900	26,804,000		

Table TE-2
Summary of the Terrebonne Basin Projects (continued)

Project No.	Project Name	Project Type	Priority List Project	Acres Created, Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acre ($/Ac)	Comments
Supporting Projects, Long-Term								
Timbalier Subbasin								
PTE-1	Bayou Terrebonne Dredging	MC		[291]	[291]	1,500,000	5,200	
PTE-14	Creation W Bayou Lafouche	MC						Interacts w/ PTE-27, XTE-52.
PTE-17	Bayou Lafourche Dredging	MC						Interacts w/ PTE-2, PTE-27, XTE-52.
PTE-21	B Terrebonne/Lafouche Channel	HR						
XTE-28	Parish Line of Defense	MM						2/
Penchant Subbasin								
PTE-8	MC W Houma N GIWW	MC		[115]	[115]	6,000,000	52,200	
PTE-13	B Chene, Boeuf, & Black WL	MC						Interacts w/ PTE-5, PTE-26.
Verret Subbasin								
XTE-31	Sediment Diversion, Verret	SD						Interacts w/ XTE-32.
XTE-34	Savanne Basin Restoration	HR				375,000		
Fields Subbasin								
TE-15	GIWW Levee Planting	VP		[24]	[24]	194,000	8,000	Interacts w/ XTE-38c.
Demonstration Projects								
PTE-10	Pt au Fer Restoration	HR		6	75	78,000	1,000	
PTE-20	Bayou Lafouche Salinity Barrier	HR						Interacts w/ XTE-52.
XTE-39	Lake Barre Oyster Reef	SP			41	301,000	7,300	
XTE-43	Red Mud Coastal Rest Demo	MC	PPL 3	3	3	529,000	58,800	
XTE-53	Pt au Fer Rest w/ Spray Dredge	MC						
XTE-54a	Flotant Creation/Enhancement	ST					674,000	Abandoned canals.
XTE-54b	Flotant Creation/Enhancement	ST					813,000	Fencing levee breaks.
XTE-61	Sediment Cypress Swamp	SD						
XTE-66	Sediment Conveyance Demo	MC		[550]	[1,080]	1,228,000	1,100	
TOTAL	TERREBONNE BASIN			32,310	106,390	309,809,000		5/

BI Barrier Island Restoration
FD Freshwater Diversion
HR Hydrologic Restoration
MC Marsh Creation with Dredged Material
MM Marsh Management
SD Sediment Diversion
SP Shoreline Protection with Structures
ST Sediment/Nutrient Trapping
VP Vegetative Plantings
1/ The project is part of Alternative G, northern portion of the zone in the vicinity of the proposed hurricane protection system.
2/ The project is part of Alternative G, southern portion of the zone in the vicinity of the proposed hurricane protection system.
3/ Deferred from PPL1
4/ Projects also serve as diversion to Timbalier subbasin
5/ Total cost and benefits for the basin plan include only those for Critical Short-Term and Supporting Short-Term Projects.
[ ] Denotes acreage not reviewed by Wetlands Value Assessment Workgroup or cost estimate order of magnitude only.

COSTS AND BENEFITS

An expenditure of approximately $310,000,000 will directly create, protect, or restore more than 32,000 acres of wetlands in the Terrebonne Basin (Table TE-3), with additional wetlands enhancement increasing the benefit to more than 100,000 acres (see Table TE-2). In the Timbalier Subbasin, implementation of critical and supporting projects which compose the short-term phase of the selected plan will offset almost one third (31 percent) of the predicted marsh loss by direct protection, restoration, or marsh creation. Additional efforts will be needed to achieve a sustainable wetlands environment in the Timbalier Subbasin, making the long-term phase of the plan--sediment import projects--and associated demonstrations necessary.

Table TE-3
Estimated Benefits and Costs of the Selected Plan 1/2/

	Acres Created, Protected, or Restored	Percent Loss Prevented	Cost ($)
Critical Short-Term			
Timbalier Subbasin	16,349	27	225,733,000
Penchant Subbasin	11,406	46	57,272,000
Fields Subbasin	na	na	na
Subtotal	27,755	32	283,005,000
Supporting Short-Term			
Timbalier Subbasin	2,269	4	16,971,000
Penchant Subbasin	2,218	9	9,018,000
Fields Subbasin	61	2	815,000
Subtotal	4,548	5	26,804,000
Total	32,303	37	309,809,000

1/ Only projects with estimates of both benefited acres and cost were included in the summary.
2/ Neither costs nor benefits are now known for the key strategies in the Verret Subbasin.
na--not applicable (no critical projects in the Fields Subbasin).

In the Penchant Subbasin, implementation of the short-term phase of the selected plan, including both critical and supporting projects, will avert or offset approximately 55 percent of the predicted loss. After hydrologic restoration is in place and flood control problems are addressed, the long-term strategy of diverting substantial amounts of Atchafalaya River water and sediment into the subbasin can be implemented, conceivably leading to no net loss of wetlands.

Although the costs and benefits for the key strategies in the Verret Subbasin are not currently known, the scale of the strategy in Verret is appropriate to the scale of stress on the cypress swamps and addresses the major portion of the problem. Only site-specific, small-scale projects are currently planned for the Fields Subbasin.

ATCHAFALAYA BASIN: SUMMARY OF BASIN PLAN

STUDY AREA

The Atchafalaya Basin is located in the central part of the coastal zone, west of the Terrebonne Basin (Figure AT-1). It encompasses 58,400 acres of wetlands in St. Mary Parish. The basin boundaries are the Mississippi River and Tributaries (MR&T) system levees below Berwick and Calumet to the north, Bayou Shaffer southward along the bank of the Lower Atchafalaya River to its mouth then following the shoreline around Atchafalaya Bay to Point Au Fer to the east, and a north-south line extending through Point Chevreuil to the west.

EXISTING CONDITIONS AND PROBLEMS

Major features in the basin include the Lower Atchafalaya River, Wax Lake Outlet, Atchafalaya Bay, and the Atchafalaya River and Bayous Chene, Boeuf, and Black navigation channel. Features of the Mississippi River and Tributaries (MR&T) flood control system, including the Old River complex and the Atchafalaya Basin Floodway system, define the flow and sediment resources entering the basin and influence the basin's evolution.

Previous Mississippi River delta complexes, including the Sale-Cypremort and the Teche deltas, formed the majority of the land within the Atchafalaya Basin. Delta growth in Atchafalaya Bay is a recent occurrence, with subaqueous delta, or land underwater, forming in the decade from 1952 to 1962 and subaerial delta, or land above the water, forming during the 1973 flood. About 16,000 acres of subaerial land exist today in the Lower Atchafalaya River and Wax Lake Outlet deltas in Atchafalaya Bay.

The Atchafalaya Basin is unique among the basins because it has a growing delta system with nearly stable wetlands. Wetland loss is minor in the areas north of Atchafalaya Bay when compared to the other basins. The total wetland loss in the area is approximately 3,760 acres between 1932 and 1990. The average loss from 1974 through 1990 is 87 acres per year. Wetland loss in this area is site dependent; loss is primarily due to erosion, human activities, and natural conversion. Storms and hurricanes cause shoreline erosion between Wax Lake Outlet and Point Chevreuil. Oil and gas pipelines disrupt the natural movement of flow and sediment within the wetlands. The development of the Lower Atchafalaya River, from a tidal to a riverine system, has created natural levees along the banks of the river, disrupting the movement of flow and sediment into the wetlands.

In Atchafalaya Bay, wetland gain, rather than loss, is taking place. However, natural processes and human activity are limiting the effectiveness of flow and sediment resources in creating new wetlands by affecting sediment delivery, deposition, and retention. Winter storm fronts, waves, and currents refine and reshape the deltas in the bay by eroding and reworking sediments. MR&T project features such as the Wax Lake Outlet Control Structure affect the location and quantity of flow and sediment entering the bay. Sediments available for delta building in the Lower Atchafalaya River delta deposit in the channel above Atchafalaya Bay. These sediments reach the delta only during significant high water events. The Chene, Boeuf, and Black navigation channel affects deposition and retention of sediments within the Lower Atchafalaya River delta. The majority of sediments conveyed by the Lower Atchafalaya River do not reach the delta; sands fall out in the navigation channel where they are dredged to maintain navigation;

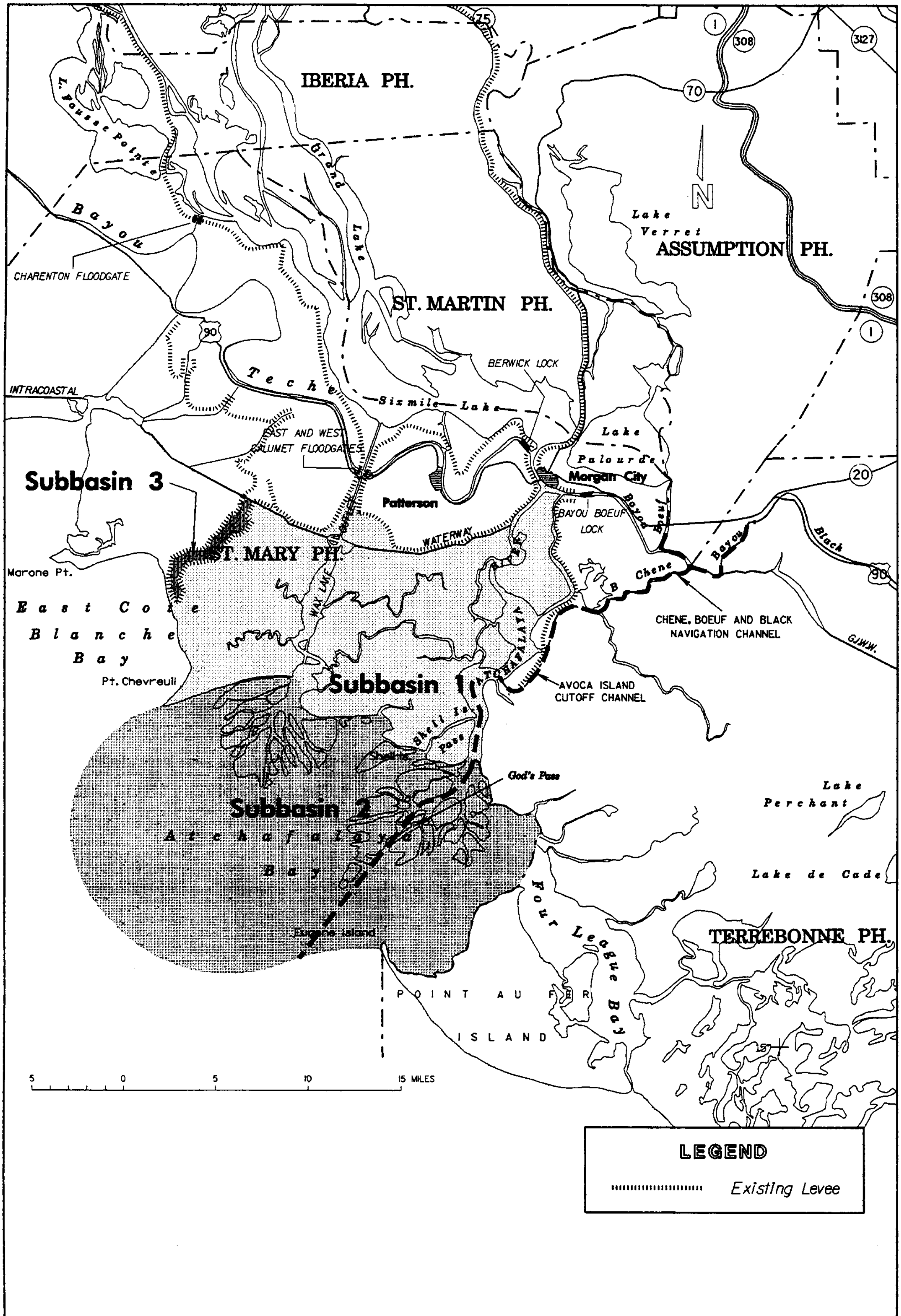


Figure AT-1. Atchafalaya Basin, Basin and Subbasin Boundaries.

silts and clays are conveyed out of the bay. The lack of sediments available for delta growth in the Lower Atchafalaya River delta is evident when the growth rate of this delta is compared to that of the Wax Lake Outlet delta. The Wax Lake Outlet delta receives approximately one- third the amount of flow and sediment of the Lower Atchafalaya River delta, and yet grows at a rate three times as great.

FUTURE WITHOUT-PROJECT CONDITIONS

Wetland loss in the area north of Atchafalaya Bay will generally continue at historical rates, resulting in 4,350 acres lost in this area in 50 years, or 8 percent of the existing acreage. Periodic overflow from the Atchafalaya system will continue to augment the wetlands, contributing to their overall stability. However, as the Lower Atchafalaya River and the Wax Lake Outlet evolve into riverine systems, natural levees will continue to form along the channel, disrupting the flow of sediment into the wetlands.

The deltas in Atchafalaya Bay will continue to grow. In 50 years, approximately 67,000 acres of subaerial delta will be present in both the Lower Atchafalaya River and the Wax Lake Outlet deltas. Of this subaerial land, approximately 27,550 acres will be vegetated wetlands--9,760 acres in the Lower Atchafalaya River delta and 17,790 acres in the Wax Lake Outlet delta, representing a gain in excess of 600 percent over the existing acreage.

As the deltas continue to grow, Atchafalaya Bay will change toward a riverine environment. Changes in salinity, water temperature, and turbidity will reduce shrimp, oyster, and marine fisheries production and increase furbearing, waterfowl and freshwater species production.

Table AT-1 shows projected wetland gain in the Atchafalaya Basin.

Table AT-1
Projected Wetlands in the Atchafalaya Basin

Measured Loss 1932-1990		Projected Gain in 20 years		Projected Gain in 50 years	
(Acres)	(Percent)	(Acres)	(Percent)	(Acres)	(Percent)
3,760	6.4	6,790	11.6	19,060	32.6

BASIN PLAN

Three strategies are available to increase the quantity of sediment delivered to Atchafalaya Bay: realign the entrance to Wax Lake Outlet, modify the Lower Atchafalaya River to increase its efficiency, and dredge sediments. Realigning the entrance to the Wax Lake Outlet is the preferred strategy. It creates more wetlands at a lower cost than the other two strategies.

Three strategies are available to reduce the quantity of sediment bypassing the Lower Atchafalaya River delta: relocate the navigation channel; relocate the flow and sediment to Wax Lake Outlet; and manage the growth of the Lower Atchafalaya River delta (delta management). Relocating the navigation channel is the preferred strategy because it solves a major problem of limited growth of the Lower Atchafalaya River delta without creating flood problems in the Teche/Vermilion

Basin or significantly reducing flow and sediment to the Terrebonne Basin. However, it has the potential for significant environmental and engineering problems. Delta management, on the other hand, can be initiated now and continue over the long term until these issues are resolved.

Delta management, relocating the navigation channel, and realigning the entrance to Wax Lake Outlet are the selected large scale measures to reduce the impact of human activity on the growth and development of wetlands in the Atchafalaya Basin. Priority projects to reopen Natal Channel and Radcliffe Pass and reduce the height of the Big Island in Atchafalaya Bay also reduce the impact of human activity in the short-term. These projects work toward the long-term goal of overall delta management. Other short-term measures support the overall basin plan. Management in the established wetlands north of Atchafalaya Bay by closing oil and gas pipelines and reopening closed distributaries, restores fluvial input disrupted by human activity and natural processes. Shoreline protection reduces erosion. Dredging sediments creates wetlands that offset loss from human activity and natural processes.

Delta management is the critical component of the plan for the basin because of its significant impact on delta growth. Reopening Natal Channel and Radcliffe Pass and reducing the height of Big Island are critical to the success of the restoration plan because they will shape the direction of future delta management activities in the Lower Atchafalaya River delta. Results of delta management will be enhanced in the long term with the relocation of the navigation channel. This long-term effort will require engineering and environmental studies to ensure a feasible plan.

The short-term portion of the plan contains projects that can be implemented under the CWPPRA with minimum effort. Small scale projects such as shoreline protection measures are effective in solving small, site dependent problems of wetland loss and erosion and creating small areas of wetlands.

In summary, the selected plan uses sediment diversion, marsh creation, and shoreline protection measures to achieve the basin objectives. The predominant feature is sediment diversion. The selected plan emphasizes management of existing resources until these resources can be increased in the future.

Nine individual projects are part of the selected plan for the Atchafalaya Basin. Table AT-2 summarizes these projects, indicating project type, cost, acres created, whether the project is critical or supporting, and if it is to be implemented in the short term or long term. Appendix F contains a detailed description of each project.

Appendix F contains a description of the plan formulation process. Figure AT-2 shows the main elements of the plan.

COSTS AND BENEFITS

The selected plan creates, protects, and restores approximately 11,090 acres of wetlands over 20 years and a total of 28,150 acres in 50 years. The three critical projects create, protect, or restore 8,110 acres of wetlands over a 20 year period at a cost of $15,981,000. In addition, these projects benefit an additional 5,960 acres. The critical long-term project, delta management, creates an additional 4,070 acres of wetlands in 50 years. Short-term supporting projects create, protect, or restore 350 acres of wetlands in 20 years at a cost of $3,407,000 and benefit an additional 2,110 acres. Long-term supporting projects create 15,630 acres in 50 years at a cost of $110,590,000.

Table AT-2
Summary of the Atchafalaya Basin Projects

Project No.	Project Name	Project Type	Priority List Projects	Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost per Benefited Acres ($/Ac)
Critical Projects, Short-Term							
PAT-2	Atchafalaya Sediment Delivery	SD, MC	PPL 2	2,230	2,790	810,000	300
XAT-7	Big Island Mining	SD, MC	PPL 2	1,560	2,020	3,821,000	1,900
Subtotal				3,790	4,810	4,631,000	
Critical Projects, Long-Term							
XAT-5	Delta Management	SD, MC		4,320	9,260	11,350,000	1,200
Supporting Projects, Short-Term							
XAT-3	Shoreline Erosion	SP		230	280	900,000	3,200
XAT-6	Booster Pump	MC		80	110	977,000	8,900
XAT-8	Dredge Sediments into Wax Lake Outlet	SD		40	2,070	1,530,000	700 ✓
Subtotal				350	2,460	3,407,000	
Supporting Projects, Long-Term							
XAT-4	Establish Wetland Management	SD, MC		800		300,000	
XAT-9	Relocate Navigation to Shell Island Pass	SD	*	9,040		90,000,000	
XAT-10	Realign Wax Lake Outlet	SD		1,840		20,290,000	
Total Atchafalaya Basin **				4,140	7,270	8,038,000	
Total Atchafalaya Basin ***				8,460	16,530	19,388,000	

MC Marsh Creation

SD Sediment Diversion

SP Shoreline Protection

* Denotes project to be implemented after 20 years. Acres shown are protected by year 50.

** Total include only Critical Short-Term Projects and Supporting Short-Term Projects.

*** Total includes Critical Short and Long-Term and Supporting Short-Term Projects.

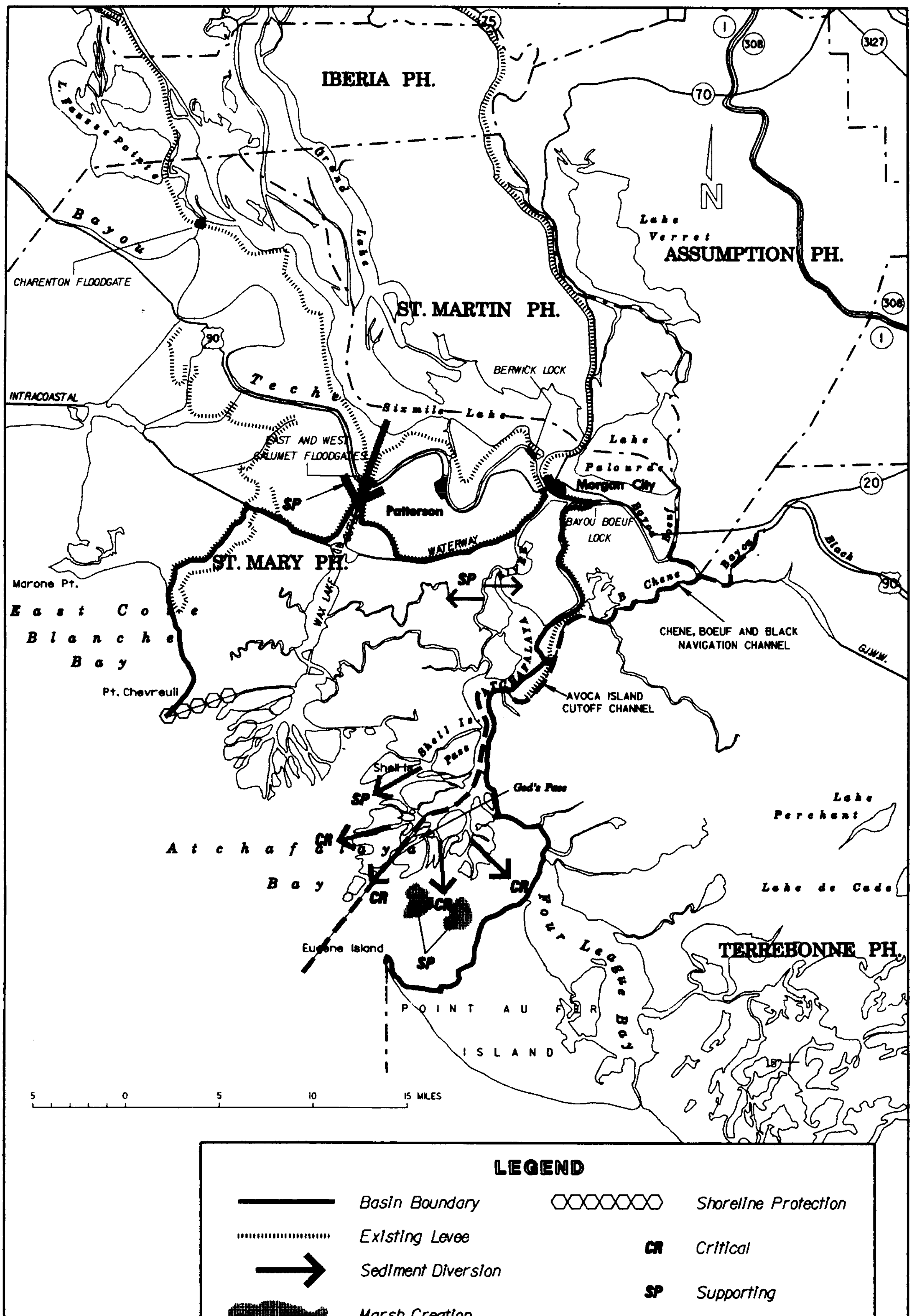


Figure AT-2. Atchafalaya Basin, Strategy Map.

TECHE/VERMILION BASIN: SUMMARY OF THE BASIN PLAN

STUDY AREA

The Teche/Vermilion Basin contains roughly 243,000 acres of wetlands in Vermilion, Iberia, and St. Mary parishes. The basin extends westward from Point Chevreuil through East and West Cote Blanche Bays, and includes Marsh Island and Vermilion Bay. The basin is bordered on the east by the West Atchafalaya Basin Protection Levee, on the west by Freshwater Bayou Canal and Louisiana Highway 82, on the north by the Lafayette/Vermilion and St. Martin/Iberia parish lines, and on the south by the Gulf of Mexico (Figure TV-1).

EXISTING CONDITIONS AND PROBLEMS

Much of the basin is occupied by three large bays: East Cote Blanche Bay, West Cote Blanche Bay, and Vermilion Bay. Marsh Island is an important hydrologic feature because it separates these bays from saltier water in the Gulf of Mexico. Therefore, marshes in this basin are primarily fresh, intermediate, and brackish with relatively few salt marshes. The Teche/Vermilion Basin lost 42,293 acres (14.8 percent) of marsh since 1932, nearly half of which was lost between 1951 and 1974, which is a relatively low rate compared to rates in other basins. Marsh loss is relatively slow because the basin is in the later stages of the delta lobe cycle; the more delicate wetlands deteriorated centuries ago. In fact, the delta lobe cycle has proceeded to the point that the basin should be experiencing rapid wetland creation in association with the emerging Atchafalaya River delta, but wetlands are not being built at maximum rates because the flow of fresh water and sediments down the Atchafalaya River is controlled at the Old River Control Structure. Fresh water and sediments from the Atchafalaya River benefit the basin nonetheless. Furthermore, numerous live and relic oyster reefs southeast of Marsh Island buffer water exchange between the big bays and the Gulf of Mexico, which also contributes stability.

Although the basin is geologically stable and benefits from the emerging Atchafalaya River delta, geomorphologic and hydrologic conditions have been altered by the dredging of navigation and petroleum access canals and the construction of spoil banks and levees. The effects of these alterations vary greatly from place to place, but generally they have created artificial barriers between wetlands and wetland maintenance processes, or removed natural barriers between wetlands and wetland decay processes. Interior marshes, traditionally maintained by annual flooding with fresh water in the spring, may deteriorate when exposed to increasing marine conditions, particularly in marshes where the soils have low mineral content. However, marshes near the Gulf of Mexico benefit from linkage with the gulf because winter storms deliver sediments to those marshes. Many landowners have responded to changing conditions caused by large-scale alterations by managing hydrologic conditions on a small scale using marsh management techniques. It is possible that some of these management efforts may not preserve marsh, particularly older ones. However, marsh management is an actively evolving field.

Some wetland loss might also be related to herbivory. Moderate herbivory alone is not believed to cause wetland loss, but it may be the "final straw" in marshes experiencing additional stresses such as flooding or saltwater intrusion.

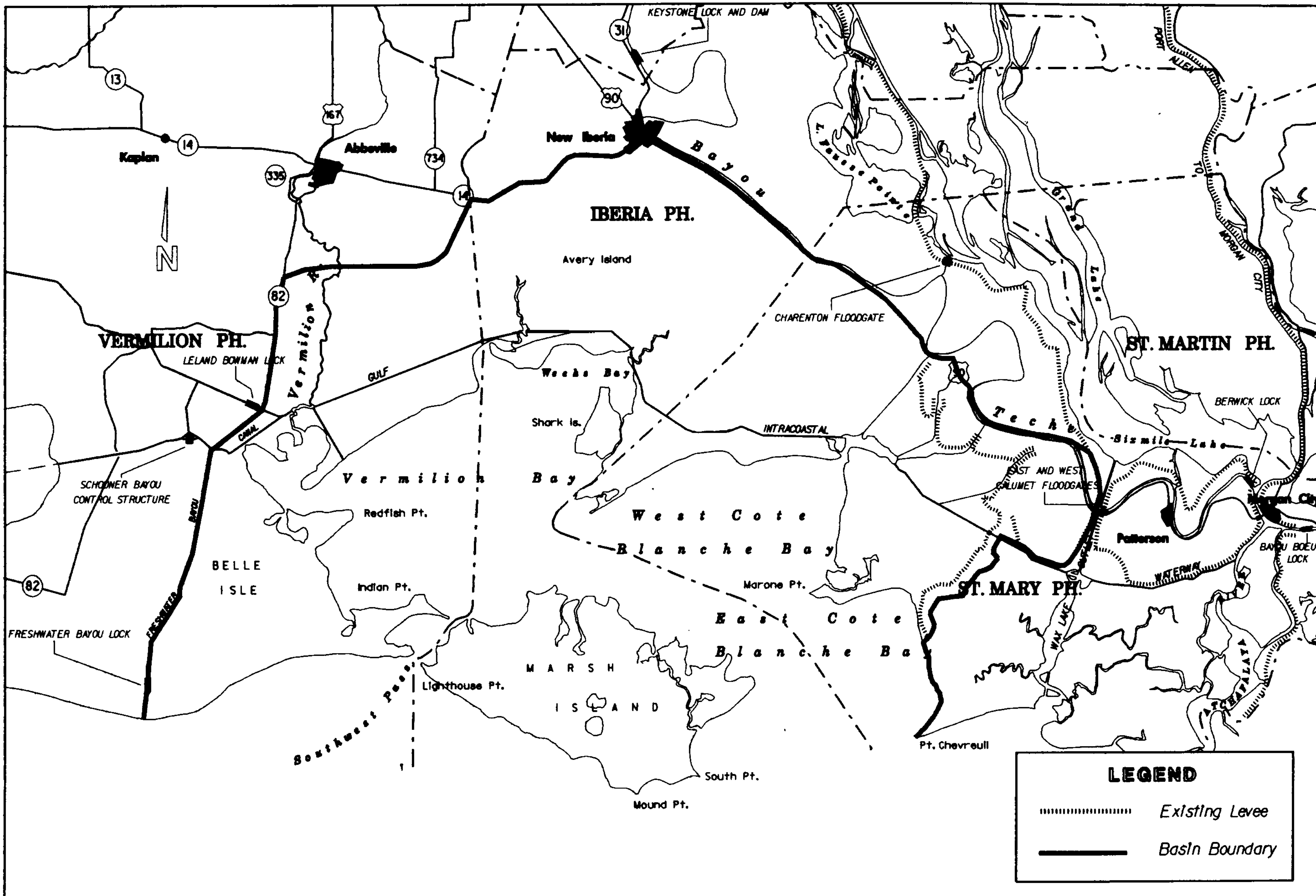


Figure TV-1. Teche/Vermilion Basin, Basin Boundaries.

Most wetland loss in the basin occurs either as shoreline erosion or in isolated hot spots. Areas are classified as hot spots when they experience rapid loss relative to other marshes within this basin. Hot spots in this basin are smaller than in other basins; they presumably originate from hydrologic changes that alter the balance between the marsh maintenance and deterioration processes, but the specific causes vary from place to place. Canals and spoil banks have impounded some areas and increased tidal energy in other areas. Thus, some areas have become isolated from sediment input, whereas water exchange removes more sediments than are introduced in other areas. Inadvertent impoundment also causes some areas to flood excessively.

Shoreline erosion on the large bays is caused primarily by natural wave energy. Wave energy has gradually increased over the centuries because the bays are naturally getting deeper due to the very slight but constant subsidence and global sea-level rise. Wave energy is also believed to have been increased because humans reduced the size of the oyster reefs between Marsh Island and Point Au Fer that shielded the large bays from wave and tidal energy in the Gulf of Mexico. Severe shoreline erosion occurs on Marone and Redfish Points, Shark Island, and the shore of Weeks Bay.

Shoreline erosion can dramatically affect wetland loss when it causes relatively isolated marsh drainage systems to become hydraulically connected with dynamic water bodies such as navigation canals and the large bays. In other areas, shoreline erosion is particularly rapid and causes the direct loss of significant wetland acreage. These may be classified as hot spots of erosion. Erosion caused by boat wakes and water surges associated with the passage of large vessels also causes wetland loss along the GIWW and other navigation canals.

FUTURE WITHOUT-PROJECT CONDITIONS

Over the next 20 years, 14,700 acres or 6.1 percent of the marsh (based on 1988 marsh acres) will be lost unless preventative measures are taken (Table TV-1). Within the next 50 years, 36,750 acres or 15.1 percent percent of the marsh will be lost. Cumulative losses since 1932 will approach 28 percent by 2040. In 50 years, shoreline erosion will reduce Marone Point, Redfish Point, and Shark Island, and Weeks Bay will be larger. The interior marshes on Marone Point, those north and south of the GIWW between the Vermilion River Cutoff and Tigre Lagoon, the south central marshes on Marsh Island, and marshes on State and Rainey refuges will become shallow ponds. This will reduce fisheries available for harvest by commercial and recreational fishermen and wintering habitat for millions of waterfowl. The growing ecotourism industry will be negatively affected, and storm surge protection will be reduced.

Table TV-1
Wetland Loss in the Teche/Vermilion Basin.

Measured Loss 1932-1990 (Acres)	Projected Loss in 20 years (Acres)	Projected Loss in 20 years (Percent)	Projected Loss in 50 years (Acres)	Projected Loss in 50 years (Percent)
42,293	14,700	6.1	36,750	15.1

BASIN PLAN

Several objectives were developed to guide protection, restoration, and creation of wetlands within the Teche/Vermilion Basin. These objectives were based on prevailing conditions in the basin. A description of the plan formulation process is contained in Appendix G.

The short-term portion of the plan is dominated by projects that protect critical shorelines, restore more natural hydrological conditions, and determine the causes of marsh loss in hot spots so that site specific counter-measures can be designed. Locations of major areas of activity are noted in Figure TV-2. The long-term goal of the plan is to maximize spring flooding of wetlands, which will require feasibility studies and coordination with adjacent basins.

Shoreline erosion will ultimately slow because the bays are gradually filling with Atchafalaya River sediments. But this may take centuries without additional flow from the Mississippi River into the Atchafalaya River. Nonetheless, it may be possible to accelerate this process in some areas, and high priority is given to projects that speed this beneficial process, such as sediment trapping in Little Vermilion Bay.

There are substantial benefits to protecting some current shorelines that shield relatively isolated marsh ponds and bayous. It is preferred that these projects use beach nourishment, dredged material, and sediment trapping, but it may be necessary to use hard structures to protect some fragile but critical shorelines. Such projects are cost effective because they prevent rapid hydrological changes from occurring throughout large areas. This is the primary focus of critical short-term projects in many areas such as Lake Sand at Marsh Island.

Several critical projects restore more natural hydrological conditions on a small scale. For example, the Cote Blanche Hydrologic Restoration project slows shoreline erosion, restores hydrologic barriers between interior marshes and the bays, and controls water exchange between the GIWW and the project area, but does not include complete enclosure by levees. The net result is that this marsh is protected from artificial water exchange and shoreline erosion, but can still flood with fresh, sediment-rich water from the Atchafalaya River that is available in the adjacent GIWW and bays each spring.

Reducing loss in "hot spots" requires various measures such as sediment trapping, hydrologic restoration, and freshwater diversion. Addressing hot spots requires site-specific techniques in different areas because causes of wetland loss and the availability of counter measures vary throughout the basin. Restoring spring flooding with fresh, sediment-rich waters may someday stop marsh loss in hot spots, but it is important to protect these areas from loss now because if they convert to ponds, they will have to be restored--a much more expensive process. Thus, these projects are also classified as critical short-term even though specific causes of wetland loss must first be determined in each hot spot. Once site specific causes of marsh loss have been determined, then appropriate techniques, e.g., sediment trapping, hydrologic restoration, and freshwater diversions, can be implemented.

Restoring spring flooding to interior marshes provides optimum salinity levels and introduces mineral sediments, which promote plant growth. Restoring spring flooding on a regional scale is an important long-term goal, but it requires increased sediment delivery to the Wax Lake Delta; managing diversions into the Vermilion

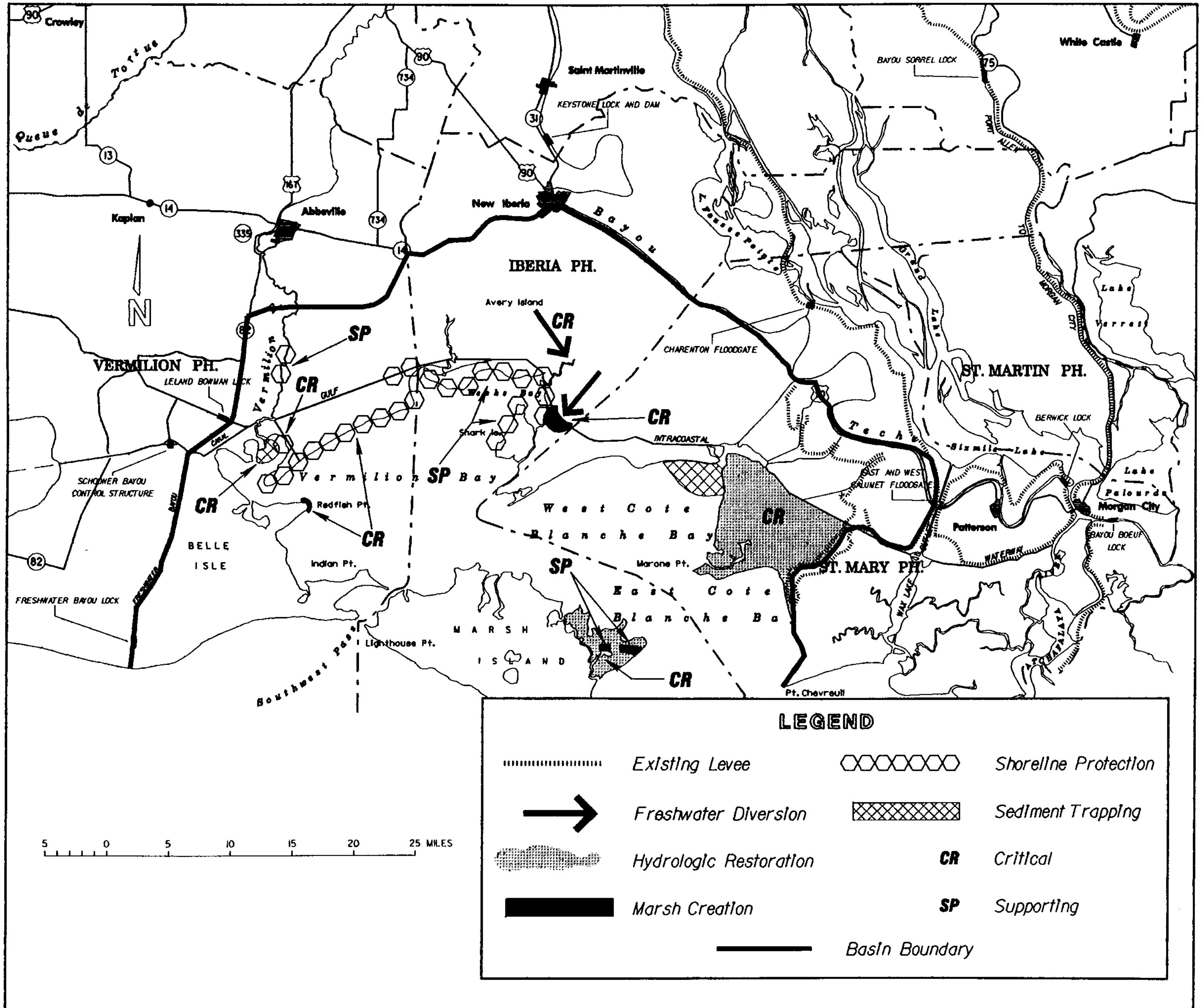


Figure TV-2. Teche/Vermilion Basin, Strategy Map.

River, Bayou Teche, and the GIWW during the spring flood; or increasing discharge of the Atchafalaya River. Increasing fresh water and sediments available from the Atchafalaya will also speed bay filling, which will slow shoreline erosion and initiate wetland creation in Vermilion Bay, West Cote Blanche Bay, and East Cote Blanche Bay. Detailed study and planning are necessary to determine if these concepts are feasible. Thus, no projects are proposed at this time even though restoring spring flooding on a regional scale is a critical long-term strategy.

Projects in the Teche/Vermilion Plan are listed in Table TV-2, which displays the project type and classification. A detailed description of all projects proposed in the Teche/Vermilion Basin can be found in Appendix G, Table 9.

COSTS AND BENEFITS

The short-term projects proposed in the selected plan will protect or create 4,770 acres of marsh and prevent 30 percent of the predicted loss at a cost of $34,039,000 (Table TV-3). In addition, 5,010 acres of marsh and submerged aquatic vegetation will be enhanced. Costs and benefits of the other three short-term critical projects cannot be determined until the site-specific causes of marsh loss can be determined in each hot spot.

Table TV-3
Costs and Benefits of the Selected Plan

Project Classification	Acres Created, Protected, or Restored	Percent Loss Prevented	Total Benefited Acres	Cost ($)
Critical Short-Term	3,840	26	8,720	22,149,000
Supporting Short-Term	930	4	1,060	11,890,000
Total	4,770	30	9,780	34,039,000

Less than half of the marsh loss predicted to occur in this basin can be countered with the projects listed in the plan. Additional efforts will therefore be needed to achieve no net loss of wetlands. Substantial gains may be possible by addressing marsh loss in the hot spots. However, the most beneficial action is likely to be maximizing spring flooding on a regional scale. In addition to slowing marsh loss processes of saltwater intrusion and sediment starvation, this would likely promote creation of new wetlands. This is one of the few basins with substantial potential for wetlands creation, and every avenue to maximize spring flooding should be explored.

Table TV-2

Summary of the Teche/Vermilion Basin Projects

Project No.	Project Name	Project Type	Priority List	Acres Created Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)
Critical Projects, Short-Term							
TV-1	Shark Island Shoreline Protect/Hyd. Restoration	SP/HR		457	591	7,559,000	12,800
TV-3	Vermilion River Cutoff Erosion Protection	SP	PPL 1	65	107	1,342,000	12,500
TV-4	Cote Blanche Hyd. Restoration	SP/HR	PPL 3	2,231	4,744	4,359,000	900
TV-5/7a	Marsh Island Canal Fill/Shore Stab./Hyd. Res.	SP/HR		512	1,090	2,328,000	2,100
TV-8	Redfish Point Shore. Prot./ Hyd. Res.	SP/HR		58	95	530,000	5,600
TV-10	Weeks Bay/GIWW Shore. Prot. /Hyd. Res.	SP/HR		406	1,422	4,993,000	3,500
PTV-19	Cote Blanche (Jaws)/Little Vermilion Bay Sed.	ST		27	505	600,000	1,200
XTV-26	Two Mouth Bayou Freshwater Diversion	FD		87	162	438,000	2,700
Subtotal: Critical Projects, Short-Term				3,840	8,720	22,149,000	
Critical Projects, Long-Term							
PTV-9	GIWW Shoreline Protection	SP					
PTV-10	Avery Canal Shoreline Protection	SP					
PTV-11	Restore Pipeline Plugs in Vermilion Bay	HR					
PTV-13	Marshes S. of GIWW, Vermilion River to Weeks Island	UK					
PTV-14	Marshes N. of GIWW, Vermilion River to Comm. Canal	UK					
PTV-17	Cote Blanche Outfall Management	HR					
PTV-21	Forested Area East of Weeks Island	UK					

Table TV-2

Summary of the Teche/Vermilion Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List	Acres Created Restored, or Protected	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)
Supporting Projects, Short-Term							
PTV-4	Vermilion River Shore. Prot., Live Oak	SP		7	70	300,000	4,300
PTV-8	Avery Canal/Weeks Isl. Veg. Plantings	VP		128	173	242,000	1,400
PTV-18/TV-9	Vermilion Bay/Boston Canal Shore. Protection	SP/ST/VP	PPL 2	378	397	829,000	2,100
XTV-11	Freshwater Bayou Bank Stab	SP		63	63	2,012,000	31,900
XTV-25	Oaks Canal Shoreline Protection	SP		120	125	1,069,000	8,600
XTV-27	Freshwater Bayou Bank Stab	SP		61	61	1,925,000	31,600
XTV-28	Freshwater Bayou Bank Stab	SP		91	91	2,888,000	31,700
XTV-29	Freshwater Bayou Bank Stab	SP		83	83	2,625,000	31,600
Subtotal: Supporting Projects, Short-Term				930	1,060	11,890,000	
Supporting Projects, Long-Term							
PTV-6	Bayou Carlin Bank Protection	SP					
PTV-7	Little Vermilion Lake Shoreline Protection	SP					
PTV-12	East/West Cote Blanche Bays Vegetative Plantings	VP					
Demonstration							
PTV-5	Cheniere au Tigre Shoreline Protection	SP					
Total Teche/Vermilion Basin *				4,770	9,780	34,039,000	

FD Freshwater Diversion

HR Hydrologic Restoration

SP Shore or Bank Projection

ST Sediment Trapping

VP Vegetative Planting

UK Unknown

* Total cost and benefits for the selected plan include only Critical Short-Term and Supporting Short-Term projects.

MERMENTAU BASIN: SUMMARY OF THE BASIN PLAN

STUDY AREA

The Mermentau Basin lies in the eastern portion of the Chenier Plain in Cameron and Vermilion Parishes. The 734,000-acre basin is bounded on the east by Freshwater Bayou Canal, on the South by the Gulf of Mexico, on the west by Louisiana State Highway 27, and on the north by the coastal prairie. The Grand Chenier and Pecan Island ridge systems are linked by Louisiana Highway 82 and divide the basin into two distinct subbasins: the Lakes Subbasin north of the highway and the Chenier Subbasin south of the highway (Figure ME-1). About 18 percent (128,200 acres) of the basin lands are publicly owned as Federal refuges and State wildlife management areas.

EXISTING CONDITIONS AND PROBLEMS

The basin contains about 450,000 acres of wetlands, consisting of 190,000 acres of fresh marsh, 135,000 acres of intermediate marsh, and 101,000 acres of brackish marsh. A total of 104,380 acres of marsh has converted to open water since 1932, a loss of 19 percent of the historical wetlands in the basin.

Prior to human alterations, delta-building processes associated with the Mississippi River resulted in periodic building of marsh along the gulf coast of the Mermentau Basin. Construction of flood control and navigation projects on the Mississippi and Atchafalaya rivers restricted those natural processes to relatively small portions of the coast. Consequently, marsh-building now occurs on only the eastern-most portion of the Mermentau Basin's coastline. This condition is further aggravated by continuing subsidence and sea level rise. In the Mermentau Basin, relative sea level rise results in an average water level rise of 0.25 inches per year. Although natural wetland building processes only occur along the eastern shore, natural marsh maintenance processes (e.g., plant deterioration and regeneration) can be fairly effective at keeping wetland loss rates low. However, these processes have been altered or interrupted and the ability of the system to maintain the marsh is jeopardized.

The two subbasins suffer from distinctly different hydrologic problems. The most critical wetland problem in the Lakes Subbasin is excessive flooding. A 5-mile-long segment of Louisiana Highway 27 almost totally blocks drainage from the western portion of the Lakes Subbasin into adjacent wetlands of the Calcasieu/Sabine Basin. Similarly, along the southern boundary of the Lakes Subbasin, Louisiana Highway 82 blocks drainage across 17 miles of marsh. The Freshwater Bayou navigation channel has altered the historic drainage pattern in the eastern portion of the Lakes Subbasin. These numerous blockages of drainage outlets significantly increase ponding in the subbasin.

The Catfish Point Control Structure, built to reduce saltwater intrusion into Grand Lake via the Mermentau River, controls the major drainage outlet from the Lakes Subbasin. High water levels in the gulf frequently prevent the drainage of the subbasin through the structure. Farther upstream, development and channelization of the Mermentau River watershed have increased the rate of run-off into the Lakes Subbasin. These factors, in combination with the loss of historic drainage outlets, result in periods of prolonged high water levels following heavy basin-wide precipitation. Because upland drainage improvements are continuing

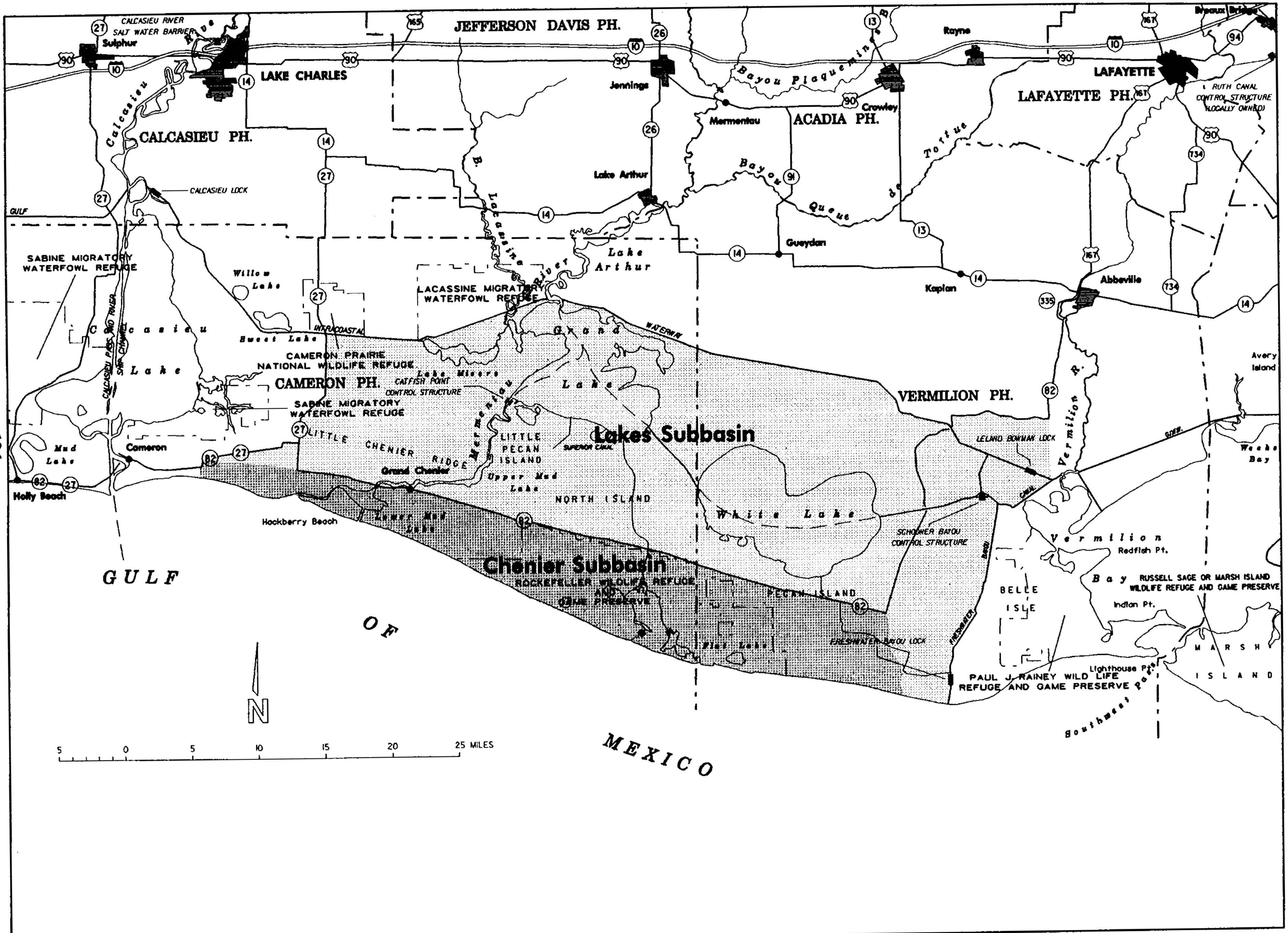


Figure ME-l. Mermentau Basin, Basin and Subbasin Boundaries.

throughout the Mermentau River watershed, high water levels in the Lakes Subbasin will remain a problem.

Natural freshwater inputs from the Lakes Subbasin into the marshes of the Chenier Subbasin are reduced by the same highway embankments that impound water in the northern subbasin. The loss of those freshwater inputs is compounded by waterways and canals that create additional connections between the gulf and area marshes, facilitating saltwater intrusion.

FUTURE WITHOUT-PROJECT CONDITIONS

If nothing is done to solve the problem of wetland loss in this basin, current estimates project a continuing loss rate of 1,980 ares per year. Table ME-1 shows projected losses for 20- and 50-year periods for each subbasin.

In absence of remedial action, about 18 percent, or 62,900 acres, of the land in the Lakes Subbasin would be lost over 50 years. This loss would occur in wetlands adjacent to the shorelines of White and Grand Lakes and the banks of the GIWW and Freshwater Bayou Canal. Interior losses would continue in the Deep Lake area, the Freshwater Bayou wetlands, and the vicinity of Little Pecan Bayou.

Chenier Subbasin wetland losses are projected to be 32 percent, or 36,100 acres, over the next 50 years. Interior wetland losses would continue to occur south of Pecan Island and Grand Chenier. Erosion along the gulf shoreline would continue at the present rate of 20 to 40 feet per year.

Table ME-1
Projected Marsh Loss

	Projected Loss at 20 yrs.		Projected Loss at 50 yrs.	
Subbasin	(Acres)	(Percent)	(Acres)	(Percent)
Lakes	25,160	7.3	62,900	18.3
Chenier	14,440	12.6	36,100	31.5
Totals	39,600	8.6	99,000	21.4

BASIN PLAN

The short-term portion of the Mermentau Basin plan depends on modifying existing structures and creating additional outlets to reduce ponding in the Lakes Subbasin and reducing salinity intrusion in the Chenier Subbasin. In addition, the plan utilizes shoreline protection, hydrologic restoration, marsh creation with dredged material, marsh management, terracing, and vegetative plantings. The long-term portion of the plan relies on hydrologic restoration and vegetative plantings. Figure ME-2 indicates the strategy for the basin. A detailed discussion of the plan formulation and evaluation process is in the Mermentau Basin Plan, Appendix H.

In the Lakes Subbasin, the short-term critical projects use two methods to move water out of the subbasin for the purpose of reducing flooding stress on vegetated wetlands: modifying the Vermilion Lock (which is no longer operational) and the
Figure ME-2. Mermentau Basin, Strategy Map

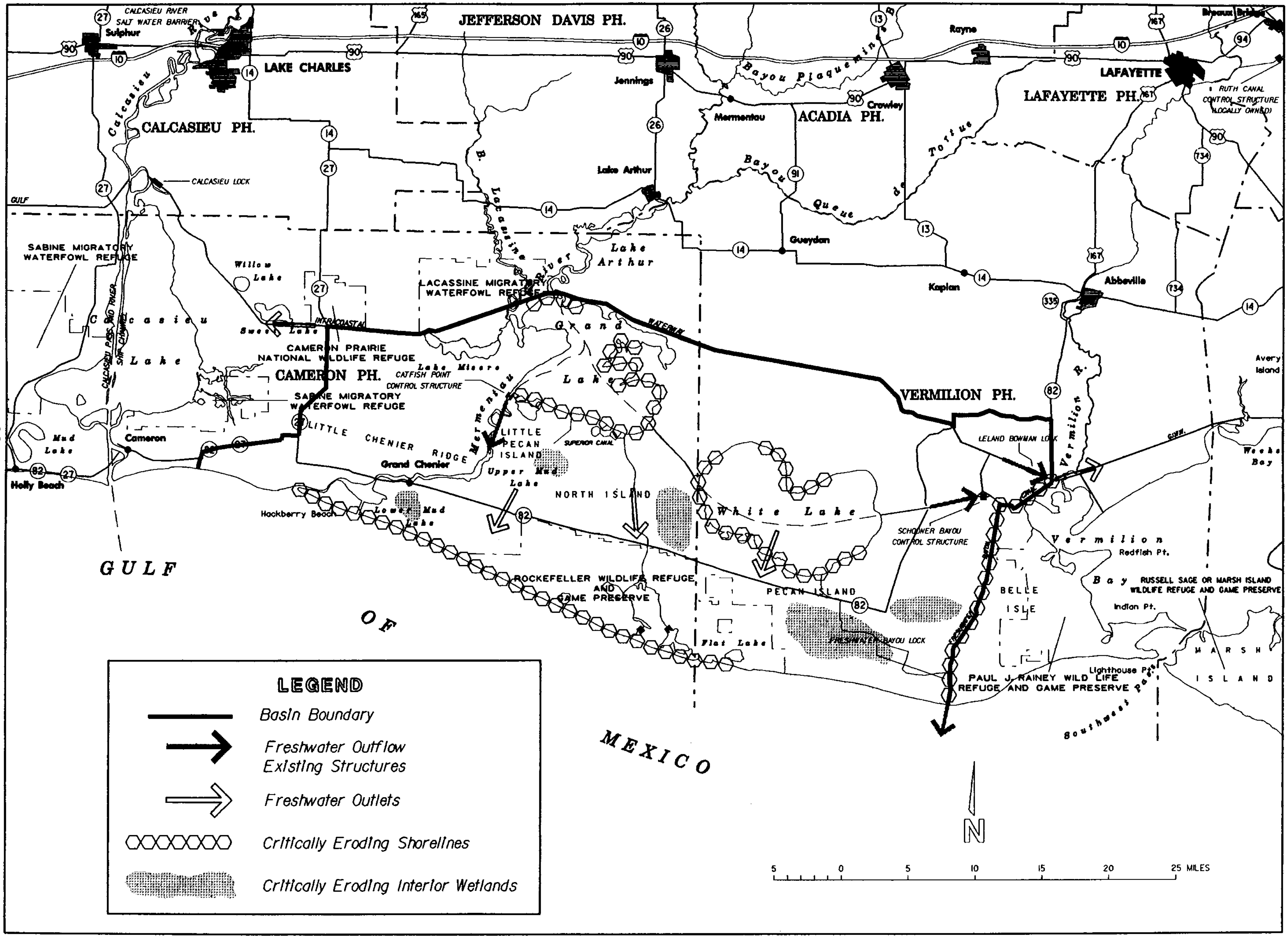


Figure ME-2. Mermentau Basin, Strategy Map.

operation of the Schooner Bayou Control Structure and Freshwater Bayou Lock, and creating additional outlets such as a structure at Black Bayou.

The short-term supporting projects within the Lakes Subbasin protect interior wetlands by hydrologic restoration (Sawmill and Humble Canals), rebuild open water areas (Big Burn and Deep Lake), and protect shorelines and banks (White Lake, Freshwater Bayou, and the GIWW).

The long-term supporting projects within the Lakes Subbasin treat critical loss areas by hydrologic restoration (Miami South Levee and Coteau Plateau Marsh) and vegetative plantings (Little Pecan Island and along the GIWW).

For the Chenier Subbasin, the short-term critical projects use water evacuated from the Lakes Subbasin to treat the saltwater intrusion problem (White Lake Diversion, Grand/White Lake Diversion, and Hog Bayou Freshwater Introduction).

The short-term supporting projects within the Chenier Subbasin protect the gulf shoreline from the Mermentau River to the eastern boundary of the Rockefeller Refuge, restore hydrology (Rollover Bayou Structure), create wetlands (Pecan Island Terracing), and plant vegetation along the gulf shoreline.

Table ME-2 lists all the projects in the selected plan. A detailed description of all projects in the selected plan is contained in Appendix H.

COSTS AND BENEFITS

Lakes Subbasin.

Implementation of the 30 evaluated projects in the selected plan (critical and supporting short-term projects) will protect, create, or restore 6,710 acres of wetlands and decrease marsh losses over a period of twenty years by an estimated 27 percent at a cost of approximately $53,358,000. Three critical hydrologic restoration projects in the subbasin were not evaluated for cost or habitat benefits and will require further study and evaluation. The benefits for these projects will depend on their ability to reduce the water levels in the subbasin. Additional projects will need to be evaluated for the subbasin for protection of acreage not covered under the present plan.

Chenier Subbasin.

The selected plan is expected to create, protect, or restore 3,150 acres of wetlands and reduce marsh loss over a period of twenty years by 22 percent at a cost of approximately $19,571,000. One project was not evaluated for cost or habitat benefits and will require further study and evaluation. There is a need to develop and evaluate other projects to achieve no net loss of wetlands. If dredging technology becomes more cost-effective, the option of pumping sediments from the gulf into shallow open water or deteriorating marshes will need to be investigated. This can only be used in the more saline subbasin marshes. It should only be done during the spring floods when the gulf salinities are the lowest in order to avoid placing sediments with higher salinities into marsh environments.

Table ME-2

Table 4. Summary of the Mermentau Basin Projects

Project No.	Project Name	Project Type	Priority List Projects	Acres Created Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
Critical Projects, Short-Term: Lakes Subbasin								
CS-16	Black Bayou Bypass	FD		115	1,661	4,600,000	2,800	Interacts w/ PME-7, in C/S Basin
XME-19	Old Vermilion Lock	FD		na	na	na	na	Interacts w/ PME-7
XME-20	Schooner Bayou Bypass	FD		na	na	na	na	Interacts w/ PME-7
XME-23	Freshwater Bayou Structure	FD		na	na	na	na	Interacts w/ PME-7
Subtotal: Critical Projects, Short-Term, Lakes Subbasin				120	1,660	4,600,000		
Critical Projects, Short-Term: Chenier Subbasin								
PME-04	White Lake Diversion	FD		126	1,133	2,000,000	1,800	Interacts w/ PME-7 & ME-1
PME-07	Grand/White Lake Diversion	FD		na	na	na		
XME-42	Hog Bayou F.W. Introduction	FD		1,274	2,264	2,000,000	900	
Subtotal: Critical Projects, Short-Term, Chenier Subbasin				1,400	3,400	4,000,000		
Supporting Projects, Short-Term: Lakes Subbasin								
ME-02	Hog Bayou Wetland	MM		20	55	6,419,000	116,700	
ME-04	Freshwater Bayou	SP	PPL2	1,593	4,513	2,032,000	500	Interacts w/ XME-29 & XME-30
ME-05	White Lake Shore Protection	SP		39	143	3,237,000	22,600	
ME-5 /XME-38	White Lake Shore Protection	SP		975	1,279	5,038,000	3,900	
ME-06	Big Burn Marsh Creation	MC		24	223	647,000	2,900	
ME-07	Deep Lake Marsh Protection	MC		127	526	1,187,000	2,300	
ME-09	Cameron Prairie Refuge	SP	PPL1	247	460	1,109,000	2,400	
PME-01	GIWW Bank Protection	SP		178	178	3,160,000	17,800	Interacts w/ XME-44
PME-03	Old GIWW Shore Protection	SP		20	20	750,000	37,500	
PME-05	Grand Lake South Shore	SP		74	86	980,000	11,400	
PME-14	Sawmill Canal	HR		229	486	1,100,000	2,300	

Table ME-2

Table 4. Summary of the Mermentau Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List Projects	Acres Created Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
Supporting Projects, Short-Term: Lakes Subbasin (Continued)								
PME-15	Humble Canal	HR		1,392	2,034	700,000	300	
XME-17	North Canal to Mermentau R.	SP		221	241	6,300,000	26,100	
XME-18	Lake Shore Rims	MC		92	92	370,000	4,000	
XME-26	Warren Canal Structure	HR		na	na	[150,000]	na	
XME-27	Seventh Ward Canal Structure	HR		na	na	[150,000]	na	
XME-28	GIWW/Freshwater Bayou	SP		60	60	700,000	11,700	
XME-29	Freshwater Bayou Phase 3	SP		118	118	3,763,000	31,900	
XME-30	Freshwater Bayou Phase 4	SP		36	36	1,138,000	31,600	
XME-31	Freshwater Bayou Phase 5	SP		36	36	1,138,000	31,600	
XME-32	Freshwater Bayou Phase 6	SP		31	31	1,000,000	32,300	
XME-33	Freshwater Bayou Phase 7	SP		25	25	788,000	31,500	
XME-35a	Umbrella Bay	SP		74	78	1,100,000	14,100	
XME-35b	Mallard Bay	SP		74	78	900,000	11,500	
XME-36	Tebo point	VP		9	11	200,000	18,200	
XME-37	Chenier DuFond	VP		15	18	840,000	46,700	
XME-38	Grand Volle Lake to Bear Lake	SP		204	242	1,000,000	4,100	
XME-40	N. Little Pecan Bayou	HR, SP		117	767	1,400,000	1,800	
XME-43	Florence Canal	HR		500	500	350,000	700	
XME-44	GIWW Bank Stabilization	SP		20	23	620,000	27,000	
XME-45	Pumpkin Ridge Structure	HR		15	136	700,000	5,100	
Subtotal Supporting Projects, Short-Term, Lakes Subbasin				6,570	12,500	48,666,000		Does not include Demo PME-06

Table ME-2

Table 4. Summary of the Mermentau Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List Projects	Acres Created Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
Supporting Projects, Short-Term: Chenier Subbasin								
PME-02	Rockefeller Gulf Shoreline	SP		850	913	9,000,000	9,900	
PME-09	Mermentau R. to Rockefeller	SP		418	450	4,200,000	9,300	
XME-22	Pecan Island Terracing	T		23	1,017	1,700,000	1,700	
XME-46	Rollover Bayou Structure	HR		150	601	400,000	700	
Subtotal Supporting Project, Short-Term, Chenier Subbasin				1,440	2,980	15,300,000		Does not include Demo ME-08
Supporting Projects, Long-Term: Lakes Subbasin								
PME-08	Miami South levee	HR				[2,380,000]		
PME-10	Little Pecan Is. Veg. Plantings	VP				[300,000]		
PME-11	GIWW Veg. Plantings	VP				[800,000]		
PME-16	Coteau Plateau Marsh	MM				[900,000]		
XME-34	Oak Grove Canal	FD				[572,000]		
XME-39	Mud Lake Levee Repair	HR				[750,000]		
XME-41	Grand Chenier Levee	HR				[900,000]		
Demonstration Project: Lakes Subbasin								
PME-06	White Lake South Shore	SP	PPL3	16	18	92,000	5,100	Supporting, short-term
Demonstration Projects: Chenier Subbasin								
ME-08	Dewitt Rollover, Veg Planting	VP	PPL1	310	331	271,000	800	Critical, short-term
Total Mermentau Basin **				9,860	20,890	72,929,000		

na Information not available
MC Marsh Creation
SP Shoreline or Bank Protection
FD Freshwater Diversion
MM Marsh Management
VP Vegetative Planting
HR Hydrologic Restoration
T Terrecing

[#] Not included in totals.

* Benefits not verified by the WVA work goup.

**Total cost and benefits for the basin plan include only those for Critical Short-Term Projects, Supporting Short-Term Projects, and Demonstration Projects.

CALCASIEU/SABINE BASIN: SUMMARY OF THE BASIN PLAN

STUDY AREA

The Calcasieu/Sabine Basin is located in southwest Louisiana in Cameron and Calcasieu parishes and consists of approximately 630,000 acres. The northern boundary of the basin is defined by the Gulf Intracoastal Waterway (GIWW). The eastern boundary follows the eastern leg of State Highway 27; the western boundary is the Sabine River and Sabine Lake; and the southern boundary is the Gulf of Mexico (Figure CS-1). About 24 percent (148,600 acres) of the basin lands is publicly owned as Federal refuges.

EXISTING CONDITIONS AND PROBLEMS

The basin contains about 312,500 acres of wetlands, consisting of 32,800 acres of fresh marsh, 112,000 acres of intermediate marsh, 158,200 of brackish marsh, and 9,500 acres of saline marsh. A total of 122,000 acres have been lost since 1932, 28 percent of the marsh that existed in 1932.

Marshes within the Calcasieu/Sabine Basin began forming about 3,500 years ago. Whenever the Mississippi River established a westerly course, large quantities of reworked riverine sediment were deposited along the gulf shore, resulting in southerly growth of the shoreline. When the Mississippi River shifted to an easterly course, the sediment supply decreased and erosive forces were greater than sediment deposition due to littoral drift. As a result, the shoreline converted to a more typical beach-like nature and gradually retreated. The repetitive occurrence of these pulses of sediment due to change in the Mississippi River's course helped to build the systems of cheniers (oak ridges) in the basin.

The progradation process served to establish an undulating land form along the gulf coast. The areas between the cheniers were collecting points for water and, over time, built up by decomposition and regeneration of plant materials to form low salinity marshes. These interior marsh areas would occasionally receive pulses of mineral sediment input due to storm tides.

Calcasieu and Sabine lakes are the major water bodies within the basin. Freshwater inflow to the basin occurs primarily through these lakes via the Calcasieu and Sabine rivers. Marshes within the basin historically drained into these two large lakes. This process was altered by the construction of channels to enhance navigation and mineral extraction activities. Navigation channels now dominate the hydrology of the basin. The Calcasieu Ship Channel is maintained at 40 feet deep by 400 feet wide and extends from the Gulf of Mexico to Lake Charles, Louisiana. The GIWW is maintained at 12 feet deep by 125 feet wide. The reach of the GIWW between the Sabine River and the Calcasieu Ship Channel was dredged to a depth of 30 feet in 1927. The Sabine-Neches Waterway, between the Gulf of Mexico and Port Arthur, Texas, is 40 feet deep by 400 feet wide.

The hydrology of the marshes between Sabine and Calcasieu lakes has also been altered by numerous relatively small access canals. The GIWW and this network of canals have established a hydrologic connections between the Sabine and Calcasieu Estuaries. Additionally, a number of bayous which once drained adjacent marshes into either of the estuaries have been connected to one another. Consequently, marshes between Sabine and Calcasieu Lakes have become a large interlinked system with water draining and circulating to the northern, eastern, and western portions of the basin.

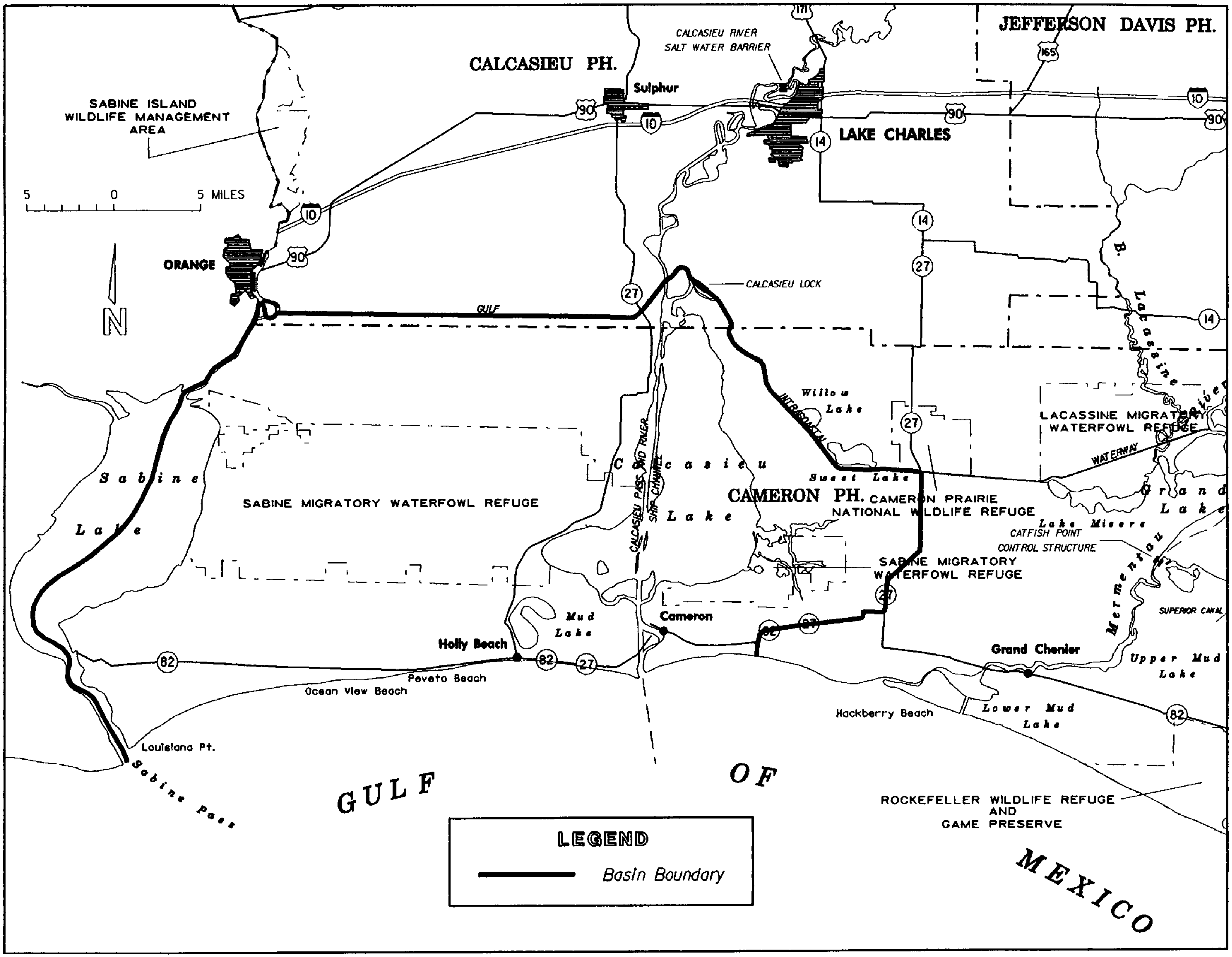


Figure CS-1. Calcasieu/Sabine Basin, Basin Boundaries.

The water circulation patterns allow for higher salinity water to enter the interior marshes (saltwater intrusion). The basin soils, which are 87 percent organic and support lower salinity marsh vegetation, are infiltrated by the more saline waters. This leads to increased stress and loss of the plant communities, and eventually erosion and sediment transport out of the inner marsh areas.

Subsidence and sea level rise are natural processes that contribute to wetland deterioration and loss. Under pristine conditions, natural marsh building and maintenance processes are effective in maintaining coastal marshes despite subsidence and sea level rise; however, human alterations have disrupted the hydrologic processes which contributed to wetland building and maintenance, while subsidence and sea level rise continues. In the Calcasieu/Sabine Basin, subsidence and sea level rise result in an average water level rise of 0.25 inches per year. Although natural wetland building processes no longer occur, natural marsh maintenance processes can be fairly effective at keeping wetland loss rates low.

Erosion is a problem along the shores of Calcasieu and Sabine lakes and the banks of the GIWW. Erosion related breaching of the lakes' shores threatens adjacent marshes because of the vulnerability of their typically weaker soils to increased water exchange and saltwater intrusion. Along the Gulf of Mexico, shoreline retreat is causing the loss of back-beach marshes and is threatening to alter the hydrology of interior marshes. Flood control projects on the Mississippi and Atchafalaya rivers, and construction of jetties on the Mermentau River, Calcasieu Ship Channel, and at Sabine Pass, have altered long shore sediment transport and sediment availability.

In summary, wetland loss within the basin is largely the result of extensive hydrologic alterations to wetland building and maintenance processes. Recent observations regarding marsh recovery indicate that in some areas, reducing salinities may protect and restore wetlands.

FUTURE WITHOUT-PROJECT CONDITIONS.

Land loss data for the period 1933 to 1990 reveals that 122,000 acres of wetlands have been lost in the basin. The current wetland loss rate of 1,100 acres per year is based on composite data for the period of 1974 to 1990. Table CS-1 shows the projected wetland loss over 20- and 50-year periods under the no action alternative.

Table CS-1
Projected Marsh Loss

	Projected Loss at 20 yrs.		Projected Loss at 50 yrs.	
Subbasin	(Acres)	(Percent)	(Acres)	(Percent)
Calcasieu	9,400	9.5	23,400	23.7
Sabine	12,500	8.4	31,200	20.9
Totals	21,900	8.9	54,600	22.0

BASIN PLAN

The Calcasieu/Sabine Basin Plan (Figure CS-2) has two possible strategies to reduce the effects of saltwater intrusion and tidal scour: locks in the major waterways or structures in the many canals where saltwater enters interior marshes.

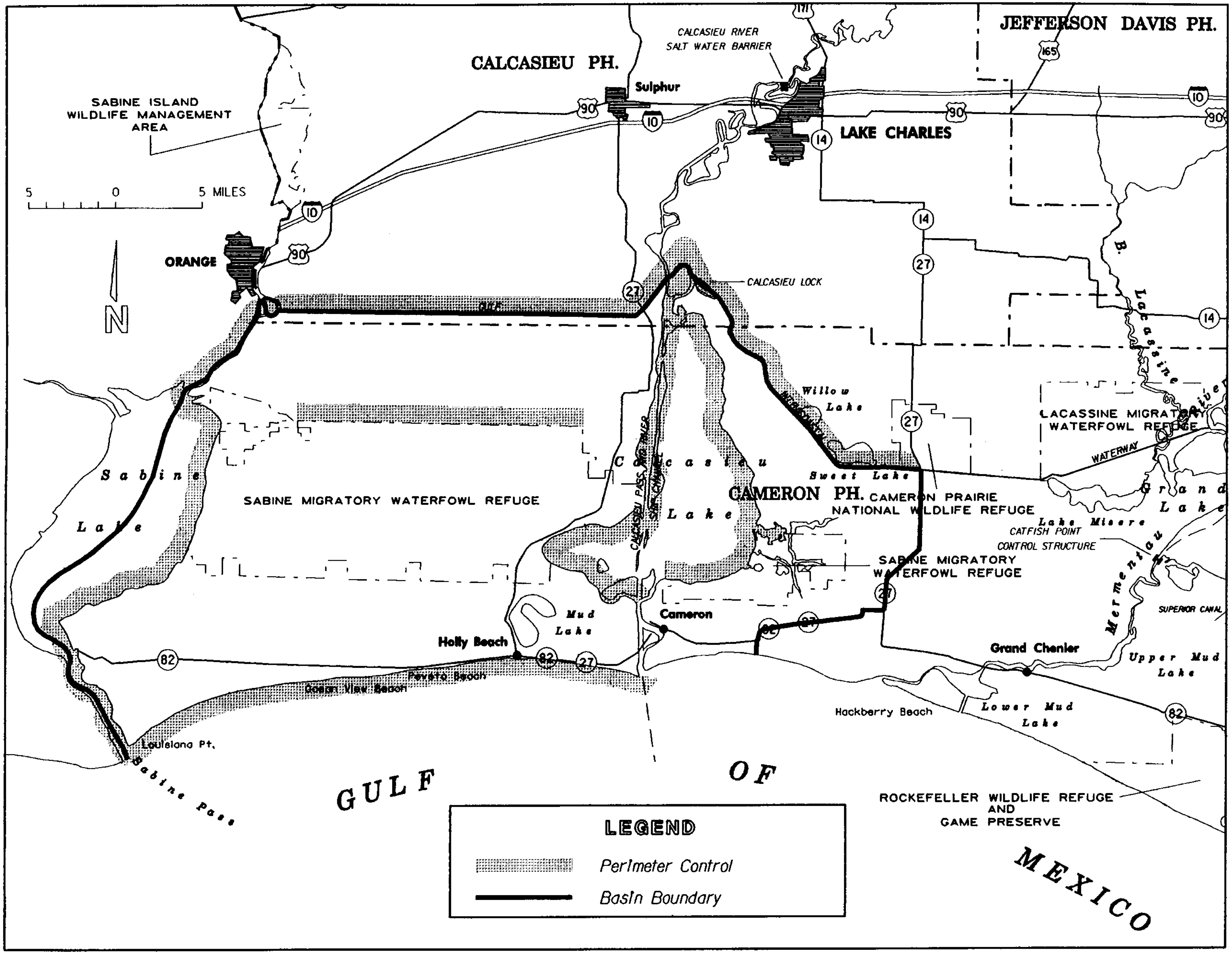


Figure CS-2. Calcasieu/Sabine Basin, Strategies 2 and 3 - Perimeter Control and Maintain Geologic Framework.

The latter is more cost effective and can be completed in a shorter time. The short-term projects in the plan include shoreline and bank protection, hydrologic restoration, freshwater introduction, marsh management, marsh creation with dredged material, and terracing. An additional freshwater introduction project is a long-term project in the basin plan. A detailed description of the plan formulation and evaluation is contained in Appendix I.

The core of the plan is structures at points where saltwater enters smaller canals that lead to interior marshes: the perimeters of Calcasieu and Sabine lakes, the Gulf of Mexico, and major waterways. This treats the adverse effects of basin-wide hydrologic alterations. Hydrologic restoration projects at Black Lake, Rycade Canal and twelve other areas, and marsh management in the Cameron-Creole area and at Brown Lake, are critical in preserving marshes. Shoreline protection projects at Sweet and Willow Lakes, from Constance Beach to Ocean View, and at five others sites, are also critical in preserving marsh. Freshwater introduction from the Toledo Bend Reservoir and marsh creation with dredged material from the Calcasieu Ship Channel are other critical projects. All these projects meet the key objectives of preserving marsh by restoring hydrology and maintaining the geological framework of the basin.

The availability of suspended sediment is limited throughout most of the basin. Freshwater diversions have been incorporated into projects where nutrient and sediment introduction may benefit wetlands. To the degree possible, actively managed perimeter structures will be opened during periods when nutrients and sediments can be introduced into wetlands.

Supporting projects are located in interior large open water areas and other severely eroding areas where perimeter projects alone would not provide a sufficient degree of protection or restoration. Bank protection at Johnsons Bayou; hydrologic restoration at Oyster and Mud Bayous and other sites; marsh management in Tripod Bayou, East Mud Lake, and Black Lake; marsh creation at Hog Island Gulley; beach nourishment with dredged material; freshwater introduction from the GIWW; sediment and nutrient trapping in Deep Lake and Browns Lake-Starks Canal area; and terracing are all supporting projects. These short-term projects help preserve the wetlands of the basin

Table CS-2 lists all the projects in the selected plan. A detailed description of projects in the selected plan can be found in Appendix I.

COSTS AND BENEFITS

The selected plan projects will protect, restore, or preserve 24,810 acres of wetlands at a cost of $136,460,000. The plan will prevent all of the marsh loss expected to occur over the next twenty years, producing a net gain of 2,910 acres of wetlands over this same period.

Table CS-2
Summary of the Calcasieu/Sabine Basin Projects

Project No.	Project Name	Project Type	Priority List Projects	Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
Critical Projects, Short-Term								
XCS-48(NO-13)	N.W. Gum cove Area	FD		200	1,171	3,013,000	2,600	Related to XCS-48a, 48b, CS-5a, 5a/12, 5b & 5b/12.
CS-5a/12	Black Bayou FW Diver. & Hydro Rest	FD/HR		376	4,311	4,263,000	1,000	Contains CS-5a &12; related to XCS-48 (NO-15,17,18,19,20, 21), PCS-10, XCS-48c & 48d.
CS-12	Black Bayopu Hydrologic Restoration	FD		[215]	[3,413]	[4,263,000]	1,200	
CS-2	Rycade Canal Structure	HR		* [3,000]	[10,000]	[650,000]		Relates to XCS-48 (NO-8), (SA-1), (SA-1a), and (SA-1b), completed by La. CRD
PCS-17	Camerol-Creole Plugs	HR	PPL1	600	1,741	534,000	300	Same as CS-17.
PCS-10	Rock Weirs	HR		23	259	1,607,000	6,200	Contained w/n CS-5a/12 & CS-12, rel. to XCS-48 (NO-17 to NO-21).
PCS-11	Sabine Lake Canal Closures	HR		12	58	2,090,000	36,000	Related to XCS-48 (NO-21), (SA-5), (SA-7), (SO-1), & (SO-2); XCS-48g.
PCS-14	Kelso Bayou Structure	HR		34	319	1,587,000	5,000	Contained w/n XCS-48 (NO-5); adj. to CS-9, XCS-48 (NO-1), XCS-53
PCS-25	Highway 384 Area	HR	PPL2	150	283	521,000	1,800	
PCS-31	Saltwater Barrier in Brannon Ditch	HR		na	na	686,000	na	Related to PCS-1
XCS-44	West Cove Canal Plug	HR		[52]	[985]	[253,000]	300	Related to XCS-48 (SA-10), contained w/n XCS-51/44.
XCS-46	North Line Canal Structure	HR		461	4,315	607,000	100	Benefits XCS-48 (SA-1),(Sa-5), (NO-14a).
XCS-47,48i,j,k&p	Replace Sabine NWR HQ Structures	HR/MM	PPL3	953	6,490	3,841,000	600	Same as XCS-48i,j,k, & p combined; will benefit XCS-48 (SA-1),(SA-2),(SA-4),(NO-8a).
XCS-48d(NO-17)	Black B. Cutoff Spoil Rep. & Rock Weir	HR		[88]	[613]	[977,000]	1,600	Contained w/n CS-5a/12, CS-5b/12, related to XCS-48 (NO-17).
XCS-48f	Structure near Long Point Bridge	HR		52	3,672	526,000	100	XCS-48 (SA-10), PCS-4.
XCS-48(NO-3)	N. Black Lake Freshwater Impound	HR		* 238	800	1,314,000	1,600	Related to PCS-1
XCS-48(NO-17)	N.W. Black Bayou Area	HR		88	613	2,322,000	3,800	Relates to CS-5a/12,5b/12, PCS-10, XCS-48b, 48d.
XCS-48(NO-18)	SE Black Bayou Area	HR		[144]	[607]	[2,153,000]	3,500	Contained w/n CS-5a/12, CS-12, related to PCS-10.
XCS-48(NO-19)	Black Bayou Area	HR		126	1,110	3,243,000	2,900	Related to CS-5a/12, CS-12, PCS-10.
XCS-48(SA-10)	W. Cove Canal Unit	HR		76	599	2,573,000	4,300	Related to XCS-47/48ijkp, XCS-44, XCS-51/44, XCS-48o, PCS-4.
XCS-52	Plug Canal near B. Peconi	HR		77	165	443,000	2,700	Related to CS-4a.
XCS-53	Alkali Ditch Structure	HR		17	303	1,587,000	5,200	Related to CS-9, PCS-14, XCS-48 (NO-1).
XCS-54	Goose Lake Restoration Project	HR		34	105	1,718,000	16,400	Related to PCS-1
XCS-51/44	Mine Calc. SC Spoil & Plug W. Cove Canal	MC/HR		235	1,056	1,929,000	1,800	Contains XCS-44, related to XCS-48 (SA-10).
CS-04a/PCS7	Cameron-Creole O&M	MM	PPL3	2,602	10,682	2,895,000	300	Contains PCS-22
CS-09	Brown Lake Hydrologic Restoration	MM	PPL2	282	1,020	2,532,000	2,500	Same as XCS-48 (NO-1) & relates to (NO-5), PCS-14, and XCS-53
CS-01a	Peveto to Holly Beach S. Protection	SP		2,723	3,890	7,280,000	1,900	Relates to XCS-48n and XCS-48 (SO-5)
CS-01c	Constance Beach to Ocean View S. Pro	SP		55	99	5,900,000	59,600	Relates to XCS-48n and XCS-48 (SO-3), part of XCS-48r
CS-11b	Sweet & Willow Lake-GIWW Bank Stab.	SP/HR		294	4,477	2,626,000	600	Contains CS-11, CS-11a, XCS-41
PCS-18	Sabine Pool 3 Levee Repair	SP	PPL1	5,542	8,985	4,484,000	500	
PCS-01	Erosion Protection along GIWW	SP		1,542	1,613	20,000,000	12,400	Related to PCS-26, PCS-27, XCS-48 (NO-19).
PCS-26	Perry Ridge, Shoreline Protection	SP		109	657	3,886,000	5,900	Part of PCS-1
PCS-27	Clear Marais	SP	PPL2	1,067	2,966	1,521,000	500	Part of PCS-1
XCS-42	GIWW Spoil Bank Maintenance	SP		814	1,517	295,000	200	Relates to CS-4a, contains CS-11, 11a, &11b.
XCS-48a	Spoil bank rep.-GIWW at Vinton Canal	SP		7	73	357,000	4,900	Part of CS-5a, CS-5a/12, XCS-48 (NO-13) & (NO-15).
Subtotal: Critcal Projects, Short-Term				18,790	63,350	86,180,000		

Table CS-2
Summary of the Calcasieu/Sabine Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List Projects	Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
Supporting Projects, Short-Term								
CS-04b	Freshwater Introduction & Outfall Mgt.	FD		132	400	1,018,000	2,500	Related to CS-4a.
CS-05a	Sabine Freshwater Introduction	FD		[376]	[4,311]	[2,228,000]	2,100	Contained w/n CS-5a/12 & 5b/12, relates to XCS-48 (NO-13,14, 14a &15).
CS-13	Back Ridge Freshwater Introduction	FD		2	27	1,425,000	52,800	Related to CS-4a, CS-4b, CS-14.
XCS-48b	Intro. Freshwater from GIWW	FD		[21]	[67]	[778,000]	11,600	Same as CS-5a, CS-5a/12, part of XCS-48 (NO13), (NO15).
PCS-12/18	Oyster Bayou & Mud Bayou Structures	HR		631	1,348	2,271,000	1,700	Contains XCS-48 (SO-8), XCS-48q, PCS-12, PCS-18.
PCS-21	Moss Lake Hydrologic Restoration	HR		19	92	1,245,000	13,500	
XCS-48(NO-05)	South Brown lake Hyd. Rest.	HR		500	1,387	3,683,000	2,700	Related to PCS-14, CS-9, XCS-48 (NO-1).
XCS-48(NO-15)	Black Bayou Cutoff Canal Area	HR		[16]	[122]	[1,617,000]	13,300	Contained w/n CS-5a/12, CS-5b/12, related to XCS-48b, XCS-48c.
XCS-48(NO-20)	W. Black Bayou Area	HR		[82]	[173]	[3,243,000]	200	Contained w/n CS-5a/12, CS-5b/12, related to PCS-10, PCS-11, PCS-17b.
XCS-48(NO-21)	SW Black Bayou Area	HR		[276]	[687]	[1,411,000]	2,100	Contained w/n CS-5a/12, CS-5b/12, related to PCS-10, PCS-11, PCS-17b.
XCS-48(SA-05)	Greens Lake Unit	HR		216	3,226	2,456,000	800	Contains part of PCS-11, related to PCS-17b.
XCS-48(SA-07)	S. Willow Bayou Unit	HR		46	777	1,707,000	2,200	Contains part of PCS-11, related to PCS-17b.
XCS-48(SA-08)	NW West Cove Unit	HR			25	332,000	13,300	Contains part of XCS-48h, related to XCS-47/48ijkp.
XCS-48(SO-01)	Johnsons Bayou Unit	HR		[1,147]	[3,854]	[2,430,000]	600	Related to PCS-11, PCS-17 b & XCS-48g.
XCS-48(SO-05)	W. Mud Lake Area	HR		300	1,281	1,017,000	800	Related to CS-1a, XCS-48l, XCS-48n.
XCS-48(SO-08)	Oyster Bayou/Lake Unit	HR		[2,080]	[7,000]	[4,989,000]	700	Major structures w/n PCS-12/18, XCS-48q, PCS-18.
XCS-48c	GIWW Canal Closures	HR		[21]	[119]	[918,000]	7,700	Related to XCS-48 (NO-15) & (NO-17).
XCS-48o	Rock Liner in Canal-SW portion of W. Cove	HR		[25]	[53]	[147,000]	2,800	Related to PCS-24, contained w/n XCS-48 (SO-7).
XCS-48m	Utilize Dredge Material-Beach Nourishment	MC		70	88	1,647,000	18,700	Related to PCS-2, benefits XCS-48 (SO-2).
XCS-48(SA-09)	Hog island Gulley Area	MC		16	644	1,329,000	2,100	Related to XCS-47/48ijkp.
XCS-50	St. Johns Island	MC		137	295	1,934,000	6,600	Related to XCS-48 (SO-8).
CS-8/ XCS-48 & (NO-2a)	Black Lake North Area	MM		14	298	1,144,000	3,800	Same as CS-8, related to PCS-23.
CS-10	Grand Lake Ridge Area	MM		662	832	1,117,000	1,300	
CS-14	Tripod Bayou	MM		51	190	1,127,000	5,900	Related to CS-4a, CS-4b, CS-13.

Table CS-2
Summary of the Calcasieu/Sabine Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List Projects	Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
Supporting Projects, Short-Term (Continued)								
PCS-24	East Mud Lake	MM	PPL2	1,520	3,121	2,268,000	700	Related to CS-1b, XCS-48 (SO6).
XCS-48n	Structure at LA Hwy. 27 W. of Holly Beach	MM	*	[na]	[500]	[224,000]	400	Related to PCS-24, contained w/n XCS-48 (SO-5).
XCS-48(NO-02)	Black Lake NE Area	MM		10	386	1,954,000	5,100	Contains part of PCS-23.
CS-01b	Holly Beach to Cal. Pass	SP		90	301	5,734,000	19,000	Relates to XCS-48 (SO-8 & 8a) and PCS-24
CS-07	West Black Lake Shore Protection	SP		120	640	743,000	1,200	Relates to XCS-48 (NO-4) and PCS-23
PCS-02(SO-02)	Breakwater at LA Point	SP		[73]	[93]	[2,227,000]	23,900	Related to XCS-48n, contained w/n XCS-48 (SO-2).
PCS-04	Long Point Lake Shore Protection	SP		25	25	710,000	28,400	Related to XCS-48 (SA-10).
PCS-29	Hebert-Precht Rip-rap	SP	*	75	250	126,000	500	Related to CS-4a
PCS-32	Bayou Choupique	SP		[30]	[30]	[667,000]	22,200	Contained w/n PCS-1.
XCS-34	Spoil along West Side CSC	SP		na	na	na		Related to XCS-48 (SA-10).
XCS-37	Rock Dike	SP		50	58	2,087,000	36,000	Located from mile 5 to 9.5 on E. side of channel.
XCS-39	Turners Bay Rock Revetment	SP		30	61	1,087,000	17,800	
XCS-48(NO-04)	West Black Lake Area	SP		[242]	[1,763]	[1,282,000]	700	Contained w/n CS-7 and PCS-23.
XCS-48(SO-02)	SW Johnsons Bayou Unit	SP		891	2,994	4,719,000	1,600	Related to PCS-11, PCS-2, XCS-48m.
XCS-36	Compost Demo Project	ST	*	10	10	250,000	25,000	Within XCS-48(NO-5) area.
XCS-48(NO-08)	S.W. Black Lake Area	ST		29	1,583	2,474,000	1,600	Related to CS-2, PCS-34.
XCS-48(NO-08a)	S. Gum Cove Area	ST		101	264	230,000	900	Related to XCS-46.
XCS-48(SA-01)	Browns Lake-Starks Canal Area	ST		87	6,583	1,619,000	200	Related to XCS-47/48lkp.
XCS-48(SA-06)	Deep Lake Bayou Unit	ST		5	789	1,185,000	1,500	
CS-15	Boudreaux-Broussard Marsh Protect	T		68	369	1,127,000	3,100	Related to CS-4a, CS-4b.
FCS-19	W. Hackberry Plantings	VP	PPL1	96	96	100,000	1,000	
PCS-34	Plantings to build bottom elevation	VP	*	2	5	128,000	25,600	w/n XCS-48 (NO-8) area.
XCS-49	Turners Bay Vegetative Planting	VP		18	18	287,000	15,900	
Subtotal: Supporting Projects, Short-Term				6,020	28,460	50,280,000		

Table CS-2
Summary of the Calcasieu/Sabine Basin Projects (Continued)

Project No.	Project Name	Project Type	Priority List Projects	Acres Created, Protected, or Restored	Net Benefited Acres	Estimated Cost ($)	Cost Per Benefited Acre ($/Ac)	Comments
Supporting, Long-Term Projects								
CS-05b/12	Sabine Freshwater Inro. & Hydro. Rest.	FD/HR		[376]	[4,311]	[8,119,000]	500	Contained w/n CS-5b &12, related to CS-5a/12, XCS-48 (NO-13, 14, 14a, &15).
XCS-33	Toledo Bend Water Mgt.	FD		920	10,770	na	na	Further study required. Benefits CS-5a/12, XCS-48 (NO-19 & 20), (SA-5 & 7) & (SO-1).
XCS-48(NO-14a)	Starks Bayou Unit	HR	*	[16]	[122]	[1,617,000]	2,000	Contained w/n CS-5a/12 and CS-12.
XCS-48(SA-01a)	S. Browns Lake-E. Hog Is. Gulley	HR	*	445	1,500	994,000	700	Related to XCS-47/48ijkp.
XCS-48(SA-01b)	E. Back Ridge Canal Area	HR	*	238	800	913,000	1,100	Related to XCS-47/48ijkp.
XCS-48(SA-02)	S. Back Ridge Canal Area	HR	*	[356]	[1,200]	[605,000]	500	Contained w/n XCS-47/48ijkp.
XCS-48(SO-04)	Four Mile Square Unit	HR	*	594	2,000	1,288,000	600	Related to XCS-47/48ijkp.
XCS-48(SO-09)	Rabbit Island	MC	*	239	300	249,000	800	Benefitted by PCS-17a.
XCS-48h(SA-08)	Rebuild spoil-S. side	MM	*	[59]	[200]	[30,000]	200	Related to XCS-47/48ijkp and XCS-48 (SA-08).
XCS-48l	Hwy. 27 culverts	MM	*	[59]	[200]	[180,000]	900	Related to XCS-48 (SA-1) & (SA-10).
XCS-48(NO-14)	W. Gum Cove-Black Bayou Area	MM	*	[120]	[400]	[994,000]	3,000	Same as CS-5a/12, CS-5b/12, & CS-12.
CS-06	Black Lake Shore Protection	SP		2	2	107,000	53,500	Relates to PCS-23
PCS-05	Calcasieu Ship Channel Erosion	SP	*	30	100	1,500,000	15,000	
XCS-38	Rock Revetment at Dugas Landing	SP	*	40	50	1,083,000	21,700	
XCS-48(SO-08a)	W. Calcasieu River Chenier	SP	*	327	1,100	11,171,000	10,200	Related to CS-1b.
XCS-48(SA-03)	Pool 3 Unit	ST	*	1,160	4,000	2,085,000	500	Related to CS-18 PPL 1 project.
XCS-48(SA-04)	Old North Bayou Unit	ST	*	356	1,200	1,036,000	900	Related to XCS-47/48ijkp.
XCS-48(SO-07)	SW West Cove Unit	ST	*	238	800	944,000	1,200	Related to XCS-48o.
XCS-48(NO-10)	E. Gum Cove Area	VP	*	[240]	[800]	[684,000]	900	Adjacent to XCS-48 (NO-4) & (NO-9).
Total Calcasieu/Sabine Basin **				24,810	91,810	136,460,000		Only Critical Short-Term and Supporting Short-Term projects included in total

FD Freshwater Diversion
HR Hydrologic Restoration
MC Marsh Creation
MM Marsh Management
SD Sediment Diversion
SP Shoreline Protection
ST Sediment/Nutrient Trapping
T Terracing
VP Vegetative Plantings
Net Benefited Acres include aquatic vegetation enhanced wetlands.
[#] Indicates cost and benefits are dulicates of other projects; values are not contained in the totals.
* Denotes benefits were not verified by the Wetland Value Assessment Work Group.
** Total cost and benefits include only Critical Short-Term and Supporting Short-Term projects
Projects in the Black Bayou region (i. e. XCS-48 (NO-13 through NO-21)) are part of an SCS Watershed Program under the authority of PL-566.

IMPLEMENTATION

In the CWPPRA, Congress did not ask the Task Force for recommendations on restoring the Louisiana Coast--it demanded real world action. The Task Force's response is to implement this Restoration Plan by building specific projects identified in the basin plan, in priority order. There will be two major tracks for this effort: 1) continued work on Priority Project Lists; and 2) new long-term efforts to build large-scale projects and to otherwise accomplish the plan objectives. The Task Force action agenda is outlined in this section.

RESPONSIBILITIES FOR IMPLEMENTATION

Putting the restoration plan into effect will require major commitments from the governments of the United States and Louisiana, and from the affected public. For its part, the Task Force will continue the existing, effective structure in which overall planning and analysis is conducted by interagency committees and work groups, and individual agencies are assigned the lead in implementation of projects and studies.

Input from the public and from the academic community has been an invaluable part of the planning process, but more needs to be done. In early 1994, the Task Force will develop and adopt a strategy to improve involvement of the public in the ongoing CWPPRA effort. Elements of the strategy are expected to include: designation of a central contact to be responsible for coordinating all public participation; use of a periodic newsletter to report on the status of projects and studies; periodic public meetings, including the annual meetings associated with development of the Priority Project List, in order to receive public input; and other activities involving both outreach and input. The revised public involvement program will be developed in conjunction with the Citizen Participation Group. An outline of a draft public involvement strategy is included in Exhibit 2.

In 1994, the Task Force will establish and fund a mechanism for securing scientific input. This input will help ensure that the evaluation, selection, and design of priority projects will be based on the best scientific information available, and that the Task Force is kept apprised of newly emerging predictive tools.

BUILDING PRIORITY PROJECTS

The Task Force will continue to select and build projects under the existing CWPPRA authorization. Key elements of this work include: submitting annual Priority Project Lists; improving procedures for selecting projects; performing project monitoring; addressing issues and conflicts which could affect project implementation; and ensuring compliance with the National Environmental Policy Act and other laws.

SUBMITTING ANNUAL PRIORITY PROJECT LISTS

The Task Force will continue to submit its annual Priority Project List to Congress as a continuation of the current authorization. Inclusive of cost-shared funds from the State of Louisiana, the total annual construction, operation, and monitoring budget is about $40 million per year. Selected projects will generally be small scale and generally will cost less than $5 million for construction, operation, and maintenance. Demonstration projects to enhance restoration science will be included in these lists.

IMPROVING PROCEDURE FOR SELECTING PROJECTS

In 1994, the Task Force will revise the procedure for selecting priority projects in order to ensure that the projects submitted to Congress make the most efficient use of the available funding, consistent with the plan. Critical projects will have a high priority, but consideration also will be given to short-term measures that can be built quickly and that contribute to the implementation of comprehensive regional strategies. The Task Force will also consider the idea of implementing important priority projects in multi-year phases. Revisions may also include modification of the evaluation process, such as the calculation of wetland values, to ensure that these procedures reflect the most current scientific information.

Now that the restoration plan is completed, time will be available to increase the level of design work done in conjunction with project evaluation; this will increase the amount of information available on each project prior to selections and rankings. Further, as noted above, the new procedures and reduced constraints on time will provide for a greater level of participation by the public and academic community.

PERFORMING PROJECT MONITORING

Detailed monitoring will be conducted on all CWPPRA-funded restoration projects, including demonstration projects, to objectively determine the degree to which programmatic and project-specific goals are achieved and to provide a basis for improved project design and operation. Monitoring will adhere to rigorous protocols that were developed by the Task Force's Monitoring Work Group, with input from the academic community (see Exhibit 5). Any revisions in those protocols will be developed with interagency participation and with collaborative input by the academic research community.

Monitoring results will provide an excellent basis for modifying existing projects to enhance their effectiveness, and for improving the selection and design of future small-scale and large-scale restoration projects. Monitoring results and associated evaluations for CWPPRA-funded projects will be provided to Congress every three years, in accordance with Section 303 (b)(7) of the CWPPRA. The State of Louisiana has been designated to develop an integrated, digitized monitoring data base. A readily accessible data base will encourage the publication of monitoring results, so that the ecosystem management techniques developed in Louisiana can be made available to, and be peer-reviewed by, a national and international audience.

ADDRESSING ISSUES AND CONFLICTS

In the process of building projects and preparing this plan, the Task Force has identified issues and conflicts which could constrain the restoration effort. These issues and conflicts arise because of the complex and dynamic nature of the wetlands loss problem, the extensive human interest (including private property interests) in the coastal zone, and the fact that projects are designed to have potentially far-reaching impacts. This situation is certain to continue as ever more ambitious projects are implemented.

As an ongoing component of project-building and other planning, the Task Force will address these issues and conflicts, recognizing that the resolution of certain issues will require authority beyond that which it has been granted. For the Task Force's part, issue resolution will be done in the context of specific projects, where designs, mitigation efforts, or other measures may be able to minimize the most severe effects on existing economic and property interests. Issues common to many projects may also be addressed in coordination with the State of Louisiana, or in the CWPPRA Conservation Plan.

ENSURING ENVIRONMENTAL COMPLIANCE

All projects must and will comply with federal, state and local statues, including but not limited to the National Environmental Policy Act (NEPA), Section 404 dredge and fill requirements of the Clean Water Act, the Endangered Species Act, and the Louisiana Coastal Zone Management Program. The Task Force will ensure that an appropriate level of environmental review and documentation will be completed for every project which is authorized for construction. The programmatic EIS for the restoration plan, which is part of this report, will support NEPA compliance, but does not substitute for the requirement that project-specific NEPA documents be prepared.

LONG-TERM EFFORTS

Two important principles are the basis for the long-range restoration goals in this plan. The first is the recognition that large, complex, innovative long-term projects are essential to ultimate restoration of Louisiana's coastal wetlands. The completion of feasibility studies is the first essential step toward the implementation of these projects. The second is that the restoration plan must be a living document, subject to modification with the finding of new facts through monitoring, the resolution of issues, and the conclusions arrived at in completing the needed feasibility studies.

FEASIBILITY STUDIES

The Task Force will immediately begin preparation of detailed feasibility studies on the large-scale projects which are the cornerstone of the plan. These studies will be funded from the $5 million allocated each year for planning purposes in the current CWPPRA funding stream. As these individual studies are completed, large-scale projects will be recommended for implementation. The costs to construct these regional scale projects will almost certainly exceed the level of funding currently provided through the CWPPRA. To build these essential projects will require authorization and adequate funding. Two means are available to pursue the construction of these measures. Following one course of action the Task Force will designate an appropriate lead federal agency for each project, and this agency will present the project, through its normal channels, to the Congress for construction authorization and funding. The second option available would be to seek an increase in the current CWPPRA allocation and execute the projects under the existing authorization.

In 1994, it is expected that priority will be given to studies investigating the feasibility of diversion of Mississippi River sediments into the basins of the deltaic plain. The specific area of the study will be developed in consultation with the State of Louisiana (Exhibit 8 consists of a letter from the Governor of Louisiana with the State's recommendations concerning feasibility studies). A study involving the enhanced management of sediments in the Atchafalaya River deltas, to optimize growth of deltaic wetlands, is currently being developed. This study, while being undertaken independently, is a direct result of the development of this plan.

As soon as possible, additional studies will be conducted, including: the evaluation of increasing diversions into the Atchafalaya River (see discussion of Section 307 (b) of CWPPRA in the introduction to this report); evaluation of sediment and flow diversions from the Mississippi and Atchafalaya rivers; regional-scale barrier island restoration or construction; and large salinity-control structures on major navigation channels.

Each feasibility study will be sharply focused to identify implementable projects that will provide regional wetland benefits through restoration of beneficial natural processes. Every effort will be made to fully utilize information gathered from previous feasibility investigations and other studies. The studies will address a wide range of economic, social, engineering, and environmental factors which impact proper project design, and will consider matters such as alternative designs and locations, cost-effectiveness, and mitigation. Development of a sediment budget for the lower Mississippi River will provide critically needed information for feasibility studies of large-scale sediment diversions. Where appropriate, hydraulic and ecological models will be used to help predict the effects of proposed large-scale restoration measures.

MAINTAINING THE PLAN AS A LIVING DOCUMENT

Just as the Louisiana coast is a dynamic environment, this Restoration Plan must be a dynamic document. The Task Force will continue to evolve the strategies presented here in light of the new information it will gather over time. The monitoring of constructed priority list projects will provide new working knowledge of wetland restoration. The resolution of significant issues may at times fall outside the authority of the Task Force, forcing changes in the execution of this plan. The completion of the needed feasibility studies will provide clearer direction for this restoration effort, and implementation of larger projects, because of their expected regional benefits, may eliminate the need for some smaller protection-oriented projects.

This evolving approach must be embraced by the member agencies of the Task Force through their commitments to coastal restoration in the execution of their overall missions. The growth of this plan will also incorporate the execution of non-CWPPRA projects and the long-term development and application of regulatory authorities. The implementation of the plan presented here will provide a road map for restoration of Louisiana's coastal wetlands.

SUMMARY

The Task Force has presented in this plan an action oriented program to respond to the Congressional mandate. The plan provides for immediate short-term actions to reduce coastal wetlands loss and prescribes long-term measures to overcome and neutralize this threat. The plan is submitted with the knowledge that the support of the citizens of the State of Louisiana, the academic community, and the Congress is necessary for its full and successful implementation. The Task

Force agencies are firmly committed to execution of the plan and will make every effort to bring long-term benefits to Louisiana and the Nation.

GLOSSARY

Accretion Deficit. That lowering of ground surface elevation due to subsidence which is not compensated by the rise in ground surface elevation due to accretion.

Average Corrected Landing. The average fishery landing (in this report from 1983 to 1990), corrected to include estimates of unreported landings, expressed in pounds per year.

Background Loss. Land loss attributable to both natural forces and manmade alterations of the land and river systems prior to 1958. For this report the annual rate of background loss was extrapolated from the 1932-1958 data set.

Batture. The alluvial land between a river at low-water stage and a levee.

Bird's Foot Delta. The modern Mississippi River delta, which resembles a bird's foot, unlike the fan-shaped deltas generally formed in shallow water.

Brackish Marsh. Wetland habitat dominated by any or several of the following plant species: Smooth Cordgrass, Black Rush, Glasswort, and Saltwort. Salinity ranges from 10 to 19 ppt.

Conservation Plan. The coastal wetlands conservation plan developed by the State of Louisiana in accordance with Public Law 101-646, Sec. 304.

Crevasse. A breach in the levee of a river.

Dedicated Dredging. The excavating of material from a water bottom for the express purpose of utilizing the material as fill in a project area.

Excess Loss. Land loss that exceeds that which is attributable to background loss.

Exvessel Price. Price received by the harvester for fish, shellfish, and other aquatic animals.

Fastlands. Lands which are separated from a coastal estuary system by levees.

Forested Wetland. Wetland habitat dominated by any or several of the following tree species: Bald Cypress, Buttonbush, Black Willow, and Water Tupelo. Salinity is 0 ppt.

Fresh Marsh. Wetland habitat dominated by any or several of the following plant species: Sawgrass, Bullwhip, Common Cattail, Roseau, Maidencane, Spikerush, and Alligator-weed. Salinity ranges from 0 to 5 ppt.

Geotextile. Man-made fabric used in the foundation of levees to minimize the size of the berms required and under stone or concrete bank armoring to retain soils.

Gross Exvessel Value. The value of a fishery calculated by applying the 1992 normalized price to the 1983-1990 average corrected landing.

Intermediate Marsh. Wetland habitat dominated by any or several of the following plant species: Deerpea, Walter's Millet, Bulltongue, Bullwhip, Sawgrass, and Saltmeadow cordgrass. Salinity ranges from 5 to 9 ppt.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. A task force required by Public Law 101-646, Title III, sec. 303(a), consisting of the Secretary of the Army, the Administrator of the Environmental Protection Agency, the Governor of the State of Louisiana, and the Secretaries of the Departments of the Interior, Agriculture, and Commerce.

Louisiana Coastal Wetlands Restoration Plan. The plan required by Public Law 101-646, Title III, sec. 303(b), to restore and prevent the loss of coastal wetlands in Louisiana.

Marine Processes. Processes which originate offshore that affect coastal marshes, such as, tides, currents, littoral drift and storm surges.

National Geodetic Vertical Datum (NGVD). The datum to which all elevations in this report are referenced. Zero NGVD roughly correlates to mean sea level along the Louisiana coast.

Natural Loss. Land loss due to subsidence, global sea level rise, sediment deprivation, and hydraulic alteration which is attributable to natural forces such as geological downwarping, compaction of the sediment column, and natural river distributary switching and levee building.

Normalized Price. The price of a fishery calculated by applying (for this report) the 1992 Consumer Price Index to the exvessel prices of (for this report) 1983 1990 catches.

Relative Sea Level Rise (RSLR). The increase in the difference between ground elevations and mean sea level elevations.

Restoration Plan. The Louisiana Coastal Wetlands Restoration Plan.

Saline Marsh. Wetland habitat dominated by any or several of the following plant species: Smooth Cordgrass, Black Rush, Glasswort, and Saltwort. Salinity ranges above 20 ppt.

Sea Level Rise. The increase of mean sea level elevations as referenced to a fixed datum.

Sediment Accretion. A rise in the ground surface elevation due to the deposition of sands, silts and clays brought by floodwaters or an accumulation of organic matter from living and dead plants.

Spoil Banks. Elevated areas along the banks of water bodies created by the deposition of dredged material.

Subsidence. The lowering of the absolute surface elevation of the land caused by geological downwarping and compaction of the sediment column by various processes both natural and man-made.

Task Force. The Louisiana Coastal Wetlands Conservation and Restoration Task Force.

Tidal Drag. The cumulative frictional force, supplied by the marshes and geomorphic features of an estuary, which resists the movement of the tide and thus decreases its amplitude.

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