FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT
LOUISIANA COASTAL WETLANDS RESTORATION PLAN

DECEMBER 1993

Lead Agency: U.S. Army Corps of Engineers, New Orleans District.
Cooperating Agencies: Environmental Protection Agency; U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Minerals Management Service, and U.S. Geological Survey; U.S. Department of Agriculture, Soil Conservation Service; U.S. Department of Commerce, National Marine Fisheries Service; and the State of Louisiana, Governor's Office of Coastal Activities and Department of Natural Resources.

ABSTRACT: The coastal wetlands of Louisiana are disappearing at the rate of about 25 square miles per year. Since the 1930's, approximately 1,500 square miles of land has been lost to open water in coastal Louisiana. Congress, realizing this tremendous loss, passed the Coastal Wetlands Planning, Protection, and Restoration Act of 1990 (CWPPRA). The CWPPRA directs the Secretary of the Army to convene a Task Force to prepare a Restoration Plan consisting of projects that provide a comprehensive approach to restoring and preventing the loss of coastal wetlands in Louisiana. The Task Force consists of the Secretary of the Army, the Administrator of the Environmental Protection Agency, the Governor of Louisiana, the Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Commerce. In practice, the Task Force members have delegated their responsibilities to other members of their organizations. The Task Force has developed a comprehensive Restoration Plan for the coastal wetlands of Louisiana. In order to accomplish this task, the wetlands were divided into nine hydrologic basins. The CWPPRA also provides funding for implementation of annual priority project lists containing priority coastal wetlands restoration projects. Three such lists have been prepared and projects included on those lists are in the process of being implemented. All projects included on the lists are also components of the Restoration Plan. The Restoration Plan contains a variety of projects that are grouped under thirteen categories: marsh management, hydrologic restoration, hydrologic management of impoundments, sediment diversion, freshwater diversion, outfall management, marsh creation (with dredged material), barrier island restoration, shoreline erosion control with structures, vegetative plantings, terracing, sediment trapping, and herbivore control. This Programmatic EIS discusses the effects expected from the various types of projects proposed for the Restoration Plan and provides an overview of the plans developed for each hydrologic basin, but does not address the effects of specific project proposals. Additional National Environmental Policy Act compliance, along with compliance with other environmental statutes, will be necessary for each project to be implemented with CWPPRA funding prior to project construction.

Date: ______________________

Please send your comments to Colonel Michael Diffley, New Orleans District Engineer, by the date stamped above. For additional information concerning this statement, please contact Mr. Richard Boe, Planning Division, U.S. Army Engineer District, P.O. Box 60267, New Orleans, Louisiana 70160-0267. Commercial telephone: (504) 862-1505.

Note: Displays, maps, figures, and other information discussed in the main report for the Restoration Plan are incorporated by reference in this Final EIS.

SUMMARY

Introduction.

The coastal wetlands of Louisiana are of National significance because of the products and values they provide to our society. Congress, recognizing this significance and the tremendous coastal wetland loss that has, and is occurring in Louisiana, passed the Coastal Wetlands Planning, Protection, and Restoration Act (CWWPRA) in 1990. A major feature of this legislation was the establishment of a Task Force, made up of five Federal agencies and the State of Louisiana, to plan and implement a comprehensive coastal wetlands Restoration Plan. The Restoration Plan is the subject of this Programmatic Environmental Impact Statement (EIS).

The CWPPRA also provides for annual priority project lists. Prior to the date on which the Restoration Plan becomes effective, the lists are to include only restoration projects that can be substantially completed during a five year period after the project is placed on the list. The first two priority project lists, submitted in November 1991 and 1992, respectively, consist of relatively small-scale projects that are in various stages of implementation. The third list will be transmitted to Congress in late 1993. All of the projects included on the first three priority project lists are also included as components of the Restoration Plan. After the completion of the Restoration Plan, subsequent annual priority lists will also be developed from the projects contained in the Restoration Plan. Funding is authorized to implement priority project lists at an annual rate of about $40 million (including the 25 percent State share) through fiscal year 1999.

The purpose of this EIS is to provide the public and decision makers with an overview of the effects to be expected from the kinds projects proposed for the Restoration Plan. The overall impacts of the Restoration Plan and its component projects cannot be determined at this time because they will depend on the specific actions that the CWPPRA ultimately funds. This Programmatic EIS does not provide National Environmental Policy Act (NEPA) compliance nor other necessary environmental compliance for any specific project. NEPA documents either have been or are being prepared separately for each of the projects contained on the first three lists and compliance will be necessary for all projects included on future annual priority lists prior to project construction.

The Planning Process.

Committees, work groups, and basin study teams, made up of Federal and State agency personnel, contractors, local governmental interests, and the academic community, were formed by the Task Force to develop the Restoration Plan. Also, a Citizen Participation Group was formed to maintain consistent public review and provide input to the plans and projects being considered, and to assist and participate in the public involvement program. Two series of scoping meetings were held in October and November 1991 - one series for coastal zone parish (county) representatives and another series for the general public. The purpose of these meetings was to identify wetland loss problems throughout the coastal zone and potential solutions to those problems. Literally hundreds of ideas were submitted to the Task Force through these scoping meetings and most of the suggestions have been included in the Restoration Plan as potential projects.

A series of plan formulation meetings were held from February to May 1992. These meetings were attended by Task Force agency representatives, members of the scientific and academic community, representatives of the Citizen Participation Group, private consultants, parish representatives, and members of the general public. Plan formulation revolved around a hydrologic basin approach to restoration. The term "basin" refers to any of Louisiana's nine major estuarine areas. During June 1992, another series of pubic meetings was held to present to the public the conceptual plans which had been developed for each basin.

During the latter half of 1992 and the first half of 1993, the Task Force's efforts were focused primarily on integrating all of the information gathered through the planning and public comment process into a comprehensive Restoration Plan. The draft version of the Restoration Plan, and accompanying EIS, was distributed to the public in mid-July 1993 and the notice of EIS availability was published in the Federal Register on July 16, 1993. The Task Force held a series of public meetings in coastal Louisiana during July and August 1993. These meetings were designed to solicit comments from the public on candidate projects being evaluated for the 3rd Priority Project List and to present the draft Restoration Plan and specific plans for restoring each basin. The formal public hearing for comments on the EIS was held on August 11, 1993 at the New Orleans District office of the U.S. Army Corps of Engineers (USACE).

Planning Considerations.

"Basin Captains" from the Federal Task Force agencies were assigned by the Task Force to act as study managers for each of Louisiana's nine coastal hydrologic basins. The Basin Captains had the responsibility for coordinating efforts of a multi-disciplined basin team to develop a restoration plan for their respective basins. Basin Captains and teams were instructed by the Task Force to take the plan formulation strategies developed by agency consensus in February to May 1992 and use this information to determine the best overall strategy for wetland restoration in each basin. In addition, projects were to be categorized as either critical to, or supporting of, the restoration of the basins.

The Task Force instructed the Basin Captains to develop the best approach to wetland restoration regardless of the cost involved. This guidance made formulation of alternatives difficult. Unless there was more than one mutually exclusive approach to overall basin restoration, the restoration plan for the basin became a combination of all non-conflicting projects.

Planning Constraints.

This Restoration Plan was assembled under the constraints imposed by its authorizing legislation, the Coastal Wetlands Planning, Protection and Restoration Act. These constraints, whether explicitly expressed or implied, affect the character of the projects, their ultimate benefit, the time frame in which the projects must be identified and analyzed, and the level of funding available for the purpose of plan formulation and development. The most significant of these are the legislative mandates concerning deadlines for submission of priority project lists and the Restoration Plan and the restriction of funds for expenditure in planning.

In the adopted study process, an attempt has been made to consider all suggested means of creating, restoring, or preventing the further deterioration of any type of coastal wetland. Many specific suggestions which have been received during this process have been burdened by the need for further development of their biological and technical backgrounds. Due to the limited availability of time and manpower to undertake these analyses, the availability of sound, verifiable data regarding specific projects has become an important consideration in selecting and developing alternative plans and projects, especially for the priority project lists.

Additionally, there are several recognized issues which must be accepted as either limiting factors or economic burdens in the design of some projects. Prominent among these issues are those of the continued protection of existing development from induced damages and the compatibility of proposed initiatives with private sector economic objectives. Some projects have the potential for producing significant changes in socioeconomic characteristics of communities along the Louisiana coast by displacing or shifting locations of existing commercial and recreational fishing areas. While these items are not considered constraints to development or recommendation of plans or projects, they do, in many cases, pose a significant monetary burden in implementing those projects.

Alternatives.

Given the difficulty with designating alternatives for restoration of each hydrologic basin, the selection of alternatives for this EIS focused on the types of projects that have been proposed for wetland creation, restoration, preservation, and enhancement. For purposes of this EIS, the proposed projects have been grouped into thirteen types. The project types are: marsh management, hydrologic restoration, hydrologic management of impoundments, sediment diversion, freshwater diversion, outfall management, marsh creation (with dredged material), barrier island restoration, shoreline erosion control with structures, vegetative plantings, terracing, sediment trapping, and herbivore control.

Environmental Consequences.

This Programmatic EIS focuses on the impacts expected from implementation of the types of projects proposed for implementation and not on effects of any specific project. Thus, discussions will necessarily, be broad and generalized. The analysis will focus on anticipated changes to the physical, biological, and socioeconomic environment that would result from implementation of any of the thirteen types of projects considered. The anticipated environmental effects are summarized in Table 1, Summary of Comparative Impacts of Proposed Project Types, on the following eight pages.

TABLE 1
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

SIGNIFICANT RESOURCES	EFFECTS OF VARIOUS PROJECT TYPES		
	NO-ACTION	MARSH MANAGEMENT	HYDROLOGIC RESTORATION
COASTAL MARSH	The rate of coastal marsh loss would probably continue its gradual decline from the present rate of about 25 square miles per year, but would remain significant.	Passive mgt. can have mixed effects on marsh vegetation. Active mgt. using draw-downs may invigorate existing marsh and cause new vegetation to develop.	Rate of marsh loss would be lowered by reducing tidal scour and moderating salinity levels.
CYPRESS-TUPELO SWAMP	Swamps would continue to deteriorate from subsidence, prolonged flooding, and saltwater intrusion.	Marsh management techniques could be used to benefit chronically flooded swamps.	Projects could be designed to benefit swamps by reducing tidal fluctuation and saltwater intrusion.
SUBMERGED AQUATIC VEGETATION (SAV)	Continued marsh loss and saltwater intrusion would reduce shallow, protected areas necessary for most species of SAV.	SAV in managed areas would likely increase due mainly to reduced tidal circulation, lowered turbidity levels, and possibly from lowered salinity levels.	SAV in restored areas would likely increase due mainly to reduced tidal circulation, lowered turbidity levels, and possibly from lowered salinity levels.
WILDLIFE RESOURCES	Populations of wildlife directly dependent on marsh and swamp would continue to decline with loss of habitat.	Projects would help maintain and possibly increase habitat values for most wildlife species, especially migratory waterfowl and furbearers and other terrestrial animals.	Beneficial effects expected due to preservation of emergent vegetation and higher incidence of submerged aquatic vegetation.
FISHERIES RESOURCES	Fisheries populations and harvests are being maintained by marsh loss adding organic material and new estuarine habitats. Fisheries harvest would decline with continued loss of marsh.	Use of managed areas by migratory estuarine species would likely be reduced to varying degrees depending on specifics of sites. Populations of resident aquatic species could increase inside areas.	Decrease in use of restored areas by estuarine species possible in some cases. Long-term benefits to fish from preservation of marsh, swamp, and submerged aquatic vegetation.
THREATENED AND ENDANGERED SPECIES	Coastal wetlands provide habitat for several listed species, including bald eagles, Arctic peregrine falcons, brown pelicans, and piping plovers. Continued habitat loss could jeopardize their recovery.	Long-term benefits to some listed species possible from wetland preservation. The National Marine Fisheries Service has expressed concern over potential cumulative effects of management on sea turtles.	No direct adverse impacts expected to listed species. Long-term benefits to some listed species possible from wetland preservation.
OYSTER LEASES	Areas leased for oyster production continue to increase as marsh is lost and estuarine open water develops. Large areas under lease would remain closed to harvest because of pollution.	Highly unlikely that areas capable of supporting significant quantities of oysters would be proposed for management. Any leases in managed areas would likely be adversely affected.	Any oysters or oyster leases within areas proposed for hydrologic restoration could be either beneficially or adversely affected by reduced tidal flows depending on site-specific conditions.
WATER QUALITY	Previously authorized freshwater diversions will restore favorable salinity regimes in some areas. Otherwise, no significant changes expected.	Projects are expected to reduce turbidity levels within managed areas and can be used to moderate and lower average salinity levels within managed areas.	Average salinity and turbidity levels are expected to decrease in restored areas.

TABLE 1 (continued)
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

EFFECTS OF VARIOUS PROJECT TYPES			
HYDRO MANAGEMENT OF IMPOUNDMENTS	SEDIMENT DIVERSION	FRESHWATER DIVERSION	OUTFALL MANAGEMENT
Optimal hydrologic conditions for growth of marsh vegetation would be restored to existing impounded areas.	This type of project is potentially the only approach capable of building enough new marsh to substantially offset losses from other sources.	Marsh loss in outfall areas would be reduced by introduction of nutrients and suspended sediments and by a reduction in salinity levels.	Projects will invigorate and restore marsh by efficient flow of freshwater with suspended nutrients and sediments across marsh and shallow open water.
The habitat value of impounded swamps could increase from hydrologic management.	Sediment diversions could benefit swamps by counteracting subsidence.	Benefits would be expected from sediment and nutrient input and flushing action of freshwater.	Swamps could be benefitted by nutrients, freshwater flow, and sediment deposition.
Coverage of SAV would increase in most project areas. With a high level of water control, SAV could be increased or decreased as desired.	SAV expected to occur in still waters between passes and in shallow water areas formed in the outfall areas. Seagrass beds could be negatively affected.	SAV is expected to increase in outfall areas from nutrient input and reduced salinity levels.	SAV is expected to increase in outfall areas from nutrient input and reduction in salinity levels.
Projects would benefit wetland-dependent wildlife in impounded areas by optimizing water levels.	Wildlife, especially migratory waterfowl, wading birds, and terrestrial animals, would be directly benefitted by an increase in wetland habitat.	Wildlife resources would be benefitted by reduction in loss of wetland habitats. Diversions would also increase vegetative vigor in receiving areas.	Wildlife resources would be benefitted by reduction in loss of wetland habitats. Management would also increase vegetative vigor in receiving areas.
Usually, only freshwater fish species would be benefitted. If tidal exchange were reestablished, estuarine species would benefit.	Some diversions would cause significant shift of estuarine fisheries species resources and expand freshwater fisheries. Long-term benefits from increased amount of wetlands expected.	Both positive and negative impacts, but overall, fisheries resources would benefit from re-establishment of favorable salinity regimes and preservation of wetland habitats.	Freshwater fisheries would likely be enhanced from distribution of freshwater and nutrients. Use of outfall managed areas by migratory estuarine species could be reduced by restrictions to access.
No direct adverse impacts expected to listed species. Long-term benefits to some listed species possible from wetland restoration.	No direct adverse impacts expected to listed species but biological assessments would be appropriate for large-scale diversions. Long-term benefits to some listed species from wetland restoration.	No direct adverse impacts expected to listed species but biological assessments would be appropriate for large-scale diversions. Long-term benefits to some listed species from wetland restoration.	No direct adverse impacts expected to listed species. Long-term benefits to some listed species from wetland restoration.
Not applicable, no oyster leases or significant amount of oysters in existing impoundments.	Diversions, depending on their location, could significantly shift areas of oyster production. Existing oyster beds could be covered with silt or killed by over-freshening.	Projects may negatively affect leases closer to diversion but would benefit leases farther away from diversions; overall net benefits expected.	Normally, no oyster leases expected within areas of outfall management. Leases adjacent to managed areas could be either positively or negatively affected.
Changes in water quality inside of impoundments may occur. No significant adverse effects expected.	Projects outside of active deltas would significantly change water chemistry. Increased nutrients, suspended sediment and lowered salinity expected.	Significant changes expected in water chemistry in outfall areas. Increased nutrients, suspended sediments, and lowered salinity expected.	No significant change in water quality expected. Average salinity levels should be lower within management areas.

TABLE 1 (continued)
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

SIGNIFICANT RESOURCES	EFFECTS OF VARIOUS PROJECT TYPES		
	NO-ACTION	MARSH MANAGEMENT	HYDROLOGIC RESTORATION
WILDLIFE REFUGES, MANAGEMENT AREAS, AND NATIONAL PARKS	Areas would continue to be managed for public use and fish and wildlife resources. Normal maintenance funding is not sufficient to maintain and restore wetlands within these areas.	Many of the western areas are already under some form of management. Additional management and maintenance of existing projects is proposed on some of these areas.	Public areas in coastal Louisiana could benefit from this type of project which reduces tidal scour and saltwater intrusion in stressed marshes.
PROPERTY OWNERSHIP AND VALUES	Existing uses include grazing, hunting, trapping, fishing, non-consumptive recreation, and oil and gas production. Continued loss of wetlands is negatively affecting these uses.	Easements would be obtained for structure sites. Existing land uses would be preserved. Some projects could reduce public access by boat giving landowners increased control over access points.	Easements would be obtained for structures sites. Existing land uses would be preserved. Structures used for some projects may hinder public access.
FLOOD PROTECTION	The storm surge-buffering effect of coastal wetlands would be reduced by continued wetland loss thereby causing greater storm-related flooding.	Possible flood protection benefits from the cumulative preservation of wetlands that provide storm surge protection.	Projects would provide flood protection benefits by reducing channelized flows and encouraging more natural sheet flow across marsh surfaces.
NAVIGATION AND OTHER FORMS OF TRANSPORTATION	The numerous navigation channels would be maintained. Increased dredging would be necessary because of the loss of wetlands that provide protection to channels.	Projects would not affect major channels. Active mgt. structures would exclude boat traffic from some areas. Structures can be fitted with boat bays in areas of high boat usage.	Projects would not affect major channels. Projects could reduce boat access into some restored areas but structures are commonly fitted with boat bays in areas of high boat usage.
RECREATION OPPORTUNITIES	Fishing and hunting activities, the two primary recreation pursuits, would be diminished by marsh loss. Non-consumptive uses would decline as well.	Hunting and freshwater fishing opportunities would likely increase in managed areas. Overall recreational catch of migratory estuarine species may be reduced but structures concentrate fish and often provide prime fishing spots.	Hunting opportunities may be increased in restored areas. Affects on fishing opportunities are not expected to be significant, except for long-term benefits from prevention of marsh loss.
CULTURAL RESOURCES	Numerous historic and prehistoric archeological sites located in the coastal wetlands would continue to be eroded and lost to subsidence.	Structures and dredging and filling activities could impact cultural resources. Site specific actions may be necessary to avoid impacts.	Structures and dredging and filling activities could impact cultural resources. Site specific actions may be necessary to avoid impacts.
SOCIOECONOMIC ITEMS	The continued loss of coastal wetlands threatens the socioeconomic stability of south Louisiana, especially the smaller coastal communities dependent upon harvestable fish and wildlife.	Socioeconomic items would be positively affected to the extent that projects maintain and protect coastal wetlands. Production of economically important estuarine fisheries may decline due to reduced access of these species into managed marsh areas.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.

TABLE 1 (continued)
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

EFFECTS OF VARIOUS PROJECT TYPES			
HYDRO MANAGEMENT OF IMPOUNDMENTS	SEDIMENT DIVERSION	FRESHWATER DIVERSION	OUTFALL MANAGEMENT
Public areas could be substantially benefitted, especially Bayou Sauvage NWR.	Depending on location, proposed projects could build wetlands on public areas in active Mississippi and Atchafalaya Deltas or cause areas to deteriorate from sediment deficit.	Diversions could benefit public areas by reducing saltwater intrusion and adding nutrients and some sediments.	Project proposed for the Salvador WMA. Likely benefits include nourishment of existing marsh with nutrients and sediment and beneficial aspects of fresh water.
Easements to manage water levels in privately owned impoundments would probably be necessary.	The state owns navigable coastal waters but ownership of water bottoms is often uncertain. Easements to be obtained on private areas that would be substantially altered.	Easements would be obtained for diversion sites but not for affected areas except where substantial alteration of conditions is expected. Existing land uses would be maintained.	Easements would be obtained for areas substantially altered by dredging, filling, structures or other activities and may be necessary over the entire managed area.
No effect on flood protection, existing protection systems would be preserved.	Diversions may create problems by raising water levels but created wetlands would help buffer flooding from storm surge.	Diversions would be constructed to maintain flood protection systems. Preserved wetlands would help buffer storms.	No adverse effect on flood protection. Indirect benefit from preservation of wetlands for storm buffering.
No effect on navigation.	Significant adverse impacts to navigation possible from large-scale diversions. Increased shoaling of river channels could result from reduction of river flows.	Major navigation channels not expected to be affected. Some reduction in use of outfall areas by small boat traffic possible.	Projects would not affect major channels. Structures and plugs may reduce boat access into management areas but traditional access routes would be maintained.
Increased recreation opportunities would occur from optimization of water levels for fish and wildlife resources.	Fishing for estuarine species would shift away from diversion site. Hunting and freshwater fishing would increase in emerging deltas. Overall net increase in recreational opportunities expected.	Fishing for estuarine species would shift away from diversion sites during high flows. Freshwater fishing and hunting would likely increase in outfall areas.	Freshwater fish and wildlife expected to be benefitted. Access by fishermen and hunters could be reduced unless structures are equipped with boat bays.
Project construction could affect cultural sites. Site specific actions may be necessary to avoid impacts.	Project construction could negatively affect cultural sites. Sites may be covered with sediments but effect would depend on site-specific conditions.	Project construction could affect cultural sites. Operations not expected to impact cultural resources.	Project construction could affect cultural sites. Site specific actions may be necessary to avoid impacts.
Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands. Site-specific, negative effects could occur from displacement of estuarine fishery resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources. Site-specific negative effects could occur from displacement estuarine fishery resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.

TABLE 1
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

SIGNIFICANT RESOURCES	EFFECTS OF VARIOUS PROJECT TYPES		
	CREATE MARSH WITH DREDGED MATERIAL	BARRIER ISLAND RESTORATION	EROSION CONTROL WITH STRUCTURES
COASTAL MARSH	Significant opportunities exist for creation of new marsh to offset other losses. Created marshes would function similar to natural ones.	Saline marsh would be increased on the islands. Protection can, in some cases, be provided to mainland marshes.	Structural materials would prevent marsh loss. Accretion can occur from breakwaters. Structures on coastlines can have mixed effects.
CYPRESS-TUPELO SWAMP	No projects proposed for development of cypress swamp on dredged material.	Projects would not effect swamps except to the extent that islands moderate salinity levels in interior areas.	Structural erosion control can be used to stop erosion of swamps to maintain swamp productivity.
SUBMERGED AQUATIC VEGETATION (SAV)	Existing SAV in marsh creation area would be replaced with emergent vegetation. Over time, SAV could establish in shallow ponds within created marsh.	No direct effects on SAV. Projects would help maintain estuarine system thereby possibly helping to maintain SAV in interior marshes.	Generally, no adverse effect on SAV. Structures can protect and enhance SAV occurring in ponds and lagoons behind eroding shorelines.
WILDLIFE RESOURCES	Direct benefits to wildlife species by a direct increase in emergent wetlands vegetation.	Restoration would provide habitat for a variety of species that use barrier islands, especially seabirds, pelicans, wading birds, and other colonial nesters.	Wildlife habitats would be preserved but structures could alter the marsh-water interface. Breakwaters in inland areas would have mainly beneficial effects.
FISHERIES RESOURCES	Fisheries usage of immediate project area may be reduced by displacement but overall benefits expected from organic production of created marsh.	Restoration of barrier islands would help to preserve the estuarine ecosystem behind the islands and the fisheries resources using the estuaries.	Fisheries habitat would be preserved but structures on shorelines would alter the marsh-water interface. Breakwaters in inland areas would have mainly beneficial effects.
THREATENED AND ENDANGERED SPECIES	No direct adverse impacts expected to listed species. Long-term benefits to some listed species possible from wetland restoration.	Brown pelicans and piping plovers, which use barrier islands, would benefit over long-term. Projects may need to be built during seasons when negative effects of construction would be minimized.	Projects would protect habitats that may be used by listed species. Long-term benefits to some listed species possible from wetland preservation.
OYSTER LEASES	Any oyster leases occurring in direct areas of marsh creation would be lost. Adjacent leases could be adversely impacted. Created marsh would provide food for oysters.	Projects would preserve estuarine areas where leases are located. Leases may be affected by dredging operations if they occur near islands or borrow areas.	Leases may be adversely affected by dredging for access to project sites, otherwise no effects.
WATER QUALITY	No significant change in water quality expected unless material contains pollutants. Temporary high turbidity and possible decreased oxygen during construction.	Dredging operations and runoff from disposal areas would temporarily increase turbidity levels. Otherwise, no long-term effects expected.	Short-term increases in turbidity expected during construction. Long-term reduction in turbidity possible from reduced erosion.

TABLE 1 (continued)
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

EFFECTS OF VARIOUS PROJECT TYPES			
VEGETATIVE PLANTINGS	TERRACING	SEDIMENT TRAPPING	HERBIVORE CONTROL
Planting of vegetation, especially smooth cordgrass, in selected areas would reduce erosion and protect marsh.	Marsh would be created in geometric patterns in open water areas. Nearby marsh would be protected by reduced wave energy.	Marsh would accrete or be developed by slowing sediment-carrying currents.	Reduction of high nutria and muskrat populations would have a beneficial effect on marsh.
Some projects are proposed to protect swamps. Cypress may be planted to slow erosion.	No projects proposed for swamps.	No projects proposed for swamps.	Reduction of high nutria populations would increase cypress regeneration.
No adverse effects. Beneficial effects when used to protect areas containing SAV.	Increased coverage of SAV would be expected in terraced areas from decreased turbidity and lower wave energy.	Sediment trapping can increase SAV by stilling wave energy and reducing water depths.	Reduction of high nutria populations would increase coverage of SAV.
No adverse impacts to wildlife. Benefits expected from preservation of habitat.	Marsh created by terracing would provide nesting, resting, and feeding areas for birds and terrestrial species.	Newly developed marsh would provide nesting, resting, and feeding areas for birds and terrestrial wildlife.	Controlling high herbivore populations would preserve wetlands habitats and its associated wildlife.
Beneficial effects from preservation of marsh-water interface and wetlands behind the shorelines.	Fish species would benefit from the large amount of marsh-water interface and shallow protected water areas developed with terracing.	Long-term benefits from protection of wetlands.	Long-term benefits to fisheries resources possible because reduced populations of animals that are contributing to wetland loss would preserve habitats that provide nursery areas for fish.
Projects would protect habitats that may be used by listed species.	No direct adverse impacts expected to listed species. Long-term benefits to some listed species possible from wetland restoration.	No direct adverse impacts expected to listed species. Long-term benefits to some listed species possible from wetland restoration.	No direct adverse impacts expected to listed species. Long-term benefits to some listed species possible from wetland restoration.
Temporary, wave-dampening devices sometimes used for plantings may negatively affect very small areas.	Highly unlikely that projects would be proposed in areas of existing oysters or oyster leases. If oysters were present, they would be negatively impacted.	Projects would not likely be proposed in areas of existing oysters or oyster leases.	Possible increase in the areas open to oyster harvest from reduction of waste from herbivores which may cause the closure of harvest areas.
A decrease in turbidity from reduced erosion may occur.	No significant change in water quality expected except for decrease in suspended sediments.	No noticeable change in water quality expected.	Controlling herbivores could reduce bacteria levels in nearby waters.

TABLE 1 (continued)
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

SIGNIFICANT RESOURCES	EFFECTS OF VARIOUS PROJECT TYPES		
	CREATE MARSH WITH DREDGED MATERIAL	BARRIER ISLAND RESTORATION	EROSION CONTROL WITH STRUCTURES
WILDLIFE REFUGES, MANAGEMENT AREAS, AND NATIONAL PARKS	Projects are proposed to build marsh on several refuges and management areas including Pass a Loutre Wildlife Management Area and Delta National Wildlife Refuge.	No projects proposed for Breton National Wildlife Refuge. Projects are proposed to restore the state-operated Terrebonne Barrier Island Refuge complex.	Projects are proposed for, and would benefit, many of the publicly owned and managed areas by reducing shoreline erosion and, sometimes more importantly, by maintaining existing managed areas.
PROPERTY OWNERSHIP AND VALUES	In some cases, ownership of newly created lands could become controversial. Dredged material disposal easements would be obtained for private lands.	Disposal easements would be obtained on privately owned properties. Existing land uses would be maintained.	Easements would be obtained on privately owned areas where structures would be placed. Existing land uses would be maintained.
FLOOD PROTECTION	Direct beneficial effect from addition of marsh capable of buffering storm surges.	Barrier islands moderate the effects of storm flooding by providing hydrologic barriers. Restoration could only help flood control efforts.	Preservation of wetlands would provide flood control benefits.
NAVIGATION AND OTHER FORMS OF TRANSPORTATION	Projects would not affect major channels. Projects would reduce small boat use in created marsh and possibly in adjacent areas.	Possible interference during construction but no long-term effects expected.	Potential interference with navigation if wetlands disappear and structures are left in open water.
RECREATION OPPORTUNITIES	Increased hunting opportunities in created marsh probable. Fishing in created marsh would be limited to open water areas within and along fringe of new marsh.	Projects would preserve high recreational use of islands and estuarine system.	Projects would preserve wetlands and their associated recreation values. Short-term interference during construction possible.
CULTURAL RESOURCES	Structures and dredging and filling activities could impact cultural resources. Site specific actions may be necessary to avoid impacts.	Cultural sites could be adversely impacted by dredging and disposal operations. Site-specific actions may be required to avoid impacts.	Cultural sites could be either adversely or beneficially impacted by structures. Site-specific actions may be required to avoid adverse impacts.
SOCIOECONOMIC ITEMS	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.

TABLE 1 (continued)
SUMMARY OF COMPARATIVE IMPACTS OF PROPOSED PROJECT TYPES

EFFECTS OF VARIOUS PROJECT TYPES			
VEGETATIVE PLANTINGS	TERRACING	SEDIMENT TRAPPING	HERBIVORE CONTROL
Vegetative plantings could be used to benefit many of the publicly owned and managed areas.	The only constructed project is on Sabine National Wildlife Refuge. Additional terracing projects possible on public areas, especially in the Chenier Plain.	Projects are proposed for Pass a Loutre Wildlife Management Area. This approach could be used to build wetlands on other public areas.	Herbivore control could benefit public areas by reducing marsh stress and marsh loss. Applicable mainly in the Deltaic Plain where herbivores are causing the most problem.
Easements would be obtained to plant vegetation on private properties. Existing land uses would be maintained.	Easements would be obtained to build terraces on private properties. Land uses not expected to change.	Easements would be obtained to place structures on private properties. No change in land use expected.	No easements necessary and no changes in land uses expected.
Preservation of wetlands would provide flood control benefits.	No adverse effect on flood protection. Created, restored, and preserved wetlands would serve to buffer storm flooding.	No adverse effect on flood protection. Created, restored, and preserved wetlands would serve to buffer storm flooding.	No adverse effect on flood protection. Indirect benefit from preservation of wetlands for storm buffering.
No effects on navigation.	No effects on navigation.	No effects on navigation.	No effects on navigation.
Projects would preserve wetland-related recreation. No adverse impacts expected.	Hunting and fishing opportunities would probably increase in terraced areas.	Developed wetlands would provide habitat for desirable wildlife species and would increase hunting potential of area.	Protection of wetlands from destruction by herbivores would preserve recreational opportunities.
Projects may prevent erosion of cultural resources, otherwise no effect expected.	Cultural sites within areas proposed for terracing unlikely. The necessity of a cultural resources survey would be determined on a case-by-case basis.	Cultural sites within areas proposed for trapping unlikely. The necessity of a cultural resources survey would be determined on a case-by-case basis.	No effects on cultural sites.
Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.	Projects would positively affect socioeconomic items to the extent that they restore and protect coastal wetlands and associated fish and wildlife resources.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

ABBREVIATIONS USED

BLH	Bottomland Hardwood Forest
BEA	Bureau of Economic Analysis
CPG	Citizen Participation Group
CWPPRA	Coastal Wetlands Planning, Protection, & Restoration Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
GIWW	Gulf Intracoastal Waterway
HUD	Department of Housing and Urban Development
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
LSU	Louisiana State University
MOA	Memorandum of Agreement
MRGO	Mississippi River Gulf Outlet
MSA	Metropolitan Statistical Area
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NWR	National Wildlife Refuge
OBERS	Office of Business Economics/Economic Research Service
OSHA	Occupational Safety and Health Administration
SAV	Submerged Aquatic Vegetation
SCS	Soil Conservation Service
SWR	State Wildlife Refuge
USACE	United States Army Corps of Engineers
USFWS	United States Fish & Wildlife Service
WMA	Wildlife Management Area

1. PURPOSE AND NEED

1.1. STUDY AUTHORITY

The Coastal Wetlands Planning, Protection, and Restoration Act of 1990 (CWPPRA) directs the Secretary of the Army to convene a Task Force to:

> ....initiate a process to identify and prepare a list of coastal wetlands restoration projects in Louisiana to provide for the long-term conservation of such wetlands and dependent fish and wildlife populations....

The CWPPRA provides that the Task Force shall consist of the Secretary of the Army, who serves as chairman, the Administrator of the Environmental Protection Agency, the Governor of Louisiana, the Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Commerce. The Secretary of the Army is also directed by the CWPPRA to transmit a priority project list to Congress not later than one year following enactment of the CWPPRA and thereafter submit lists annually. Funding is authorized for developing annual priority project lists at the rate of about $40 million annually through fiscal year 1999. The First and Second Priority Project Lists have been submitted to Congress and funding is available for construction of projects on those lists. The Third Priority Project List will be transmitted to Congress in late 1993.

The CWPPRA directs the Task Force to:

> ....prepare a plan to identify coastal wetlands restoration projects, in order of priority, based on cost-effectiveness of such projects in creating, restoring, protecting, or enhancing the long-term conservation of coastal wetlands, taking into account the quality of such coastal wetlands.... Such restoration plan shall be completed within three years from the date of enactment of this title.

The title was enacted on November 28, 1990. Therefore, the Restoration Plan should have been submitted to Congress by November 28, 1993. Due to voluminous comments received on the draft report, requiring substantial revisions, the final Restoration Plan report will likely be submitted to Congress in late 1993, or possibly early 1994. The Restoration Plan, and its potential to significantly affect the environment, are the reasons for preparing this Programmatic EIS.

1.2. BACKGROUND ON COASTAL WETLAND LOSS IN LOUISIANA

Most of coastal Louisiana is the product of alluvial deposits by the meandering Mississippi River over geologic history and the reworking of the material by natural processes. Over approximately the last 7,000 to 8,000 years, the Mississippi River built and abandoned a series of seven delta lobes that formed what is now the Deltaic Plain between Vermilion Bay and the Chandeleur Islands (Figure 1 of the Exectutive Summary). Vast amounts of alluvial material were further transported westward by prevailing currents and developed the Chenier Plain of southwest Louisiana and southeast Texas. During this period of geologic time, abandoned deltas were undergoing deterioration while other delta lobes were developing but wetland gains outweighed wetland losses. Since the time when Europeans first began settling in the lower Mississippi Valley, the Mississippi River has followed essentially the same course, flowing into the gulf at the southeastern tip of Louisiana. In the past several hundred years, the delta has extended itself far out onto the continental shelf and much of the sediment transported by the river is being lost to the Gulf of Mexico. Levees constructed along the river and closures of historic distributaries for flood control prevent the natural process of overbank flooding and deposition of sediments in the wetlands bordering the river. The marsh creation and maintenance processes driven by spring flooding of the major rivers are no longer operating because of the Nation's energy, flood protection, and commerce needs. Furthermore, the natural marsh decaying processes of sediment starvation, subsidence, and saltwater intrusion, which are associated with abandoned deltas, continue and have been greatly accelerated by the same needs that prevent natural marsh creation. Despite the fact that great quantities of sediment continue to flow through the active Mississippi River Delta, this area has experienced massive wetland losses mainly because of high subsidence rates normally associated with compaction of the unconsolidated, underlying alluvial deposits in young deltaic formations. Also, the navigation channel through the Southwest Pass of the Mississippi River carries much of the heavier sediments transported by the river into areas of the Gulf of Mexico that are too deep for wetland development. Preventing further marsh loss, given such large-scale natural processes and human activity, will require an integrated series of large-scale and small-scale projects, such as those listed in the Restoration Plan, rather than continued piecemeal and weakly coordinated efforts.

Approximately 30 percent of the combined Red and Mississippi Rivers' average annual flow is directed to the Atchafalaya River at the Old River Control Structure. A new delta at the mouth of the Atchafalaya River has formed in Atchafalaya Bay since the flood of 1973. This relatively small area of wetland gain, created by sediment deposition, is the only appreciable area of wetland gain in coastal Louisiana. The rest of the coastal area is undergoing various rates of deterioration and loss.

The rate of coastal wetlands loss began accelerating above modern historic levels during the twentieth century. Between the 1930's and 1990, approximately 1,526 square miles of land was disappeared and became to open water in coastal Louisiana. Of that amount, about 74 percent was lost in the Deltaic Plain and 26 percent in the Chenier Plain. Nearly half of the total loss was during the time period between 1956/58 and 1974. This was a period of extensive canal and channel dredging for oil and gas activities and navigation. The land loss rate for coastal Louisiana has decreased from a high of approximately 42 square miles per year between 1956 and 1974 to approximately 25 square miles per year between 1983 and 1990. The highest land loss rates and percentage of loss are occurring in and near the active Mississippi River Delta and in the eastern and south-central portions of the Deltaic Plain (Dunbar et al., 1992). These figures include losses of both wetlands and non-wetlands but virtually all of the loss is in tidally-influenced wetlands. Average annual land loss rates are displayed graphically in Figures 6 and 7 of the main report.

The primary wetland habitat type being lost in coastal Louisiana is marsh. Sizable areas of coastal cypress swamps have also been lost but attention has been focused on marsh because of the magnitude of the problem. In some areas, such as in the Central Wetlands of St. Bernard Parish, cypress swamp killed by saltwater intrusion has successfully converted to functional brackish marsh. Many, if not all, of the reasons given for marsh loss also apply to the loss of swamp.

Detailed discussion of the factors contributing to marsh loss is presented in the Restoration Plan (main report). Since this EIS and the main report are bound in the same volume and will always be circulated together, duplication of the discussion is unnecessary. Please refer to the chapter of the main report entitled, The Problem. Two important items to consider when reading the discussions about marsh loss are that 1) the reasons for marsh loss are both natural and man-induced, and 2) multiple factors usually contribute to the loss of marsh.

1.3. GOALS OF THE PROGRAMMATIC EIS

The CWPPRA Restoration Plan, and its potential for significantly affecting the environment, is the reason for this Programmatic EIS. The first two annual priority project lists were transmitted to Congress without National Environmental Policy Act (NEPA) compliance. This was a necessity due to stringent time constraints imposed by the CWPPRA. The Task Force has directed that NEPA documents, EIS's and Environmental Assessments (EA's), be prepared for all individual projects included on those lists prior to approving them for construction. The projects contained in those lists are part of the overall Restoration Plan.

This EIS will identify the potential environmental effects of the projects and other actions proposed for the CWPPRA Restoration Plan. The effects of the individual proposed projects will not be quantified but rather the effects will be discussed in general terms with specific project examples used for illustration. Many of the projects contained in the Restoration Plan are little more than conceptual ideas and, in other cases, problem areas have been identified, but the manner by which to address the problems has not been determined. The overall impacts of the Restoration Plan and its component projects cannot be determined at this time because they will depend on the specific actions that the CWPPRA funds.

The Restoration Plan contains a variety of methods and measures for creating, restoring, and preserving coastal wetlands. Some of these proposals are small in scale and would have minimal effects outside of their geographical footprint. Other large-scale projects would affect the ecology of one or more hydrologic basins. Cumulatively, the projects proposed in the Restoration Plan would affect most of coastal Louisiana.

The projects proposed in the Restoration Plan far exceed funding provided by the CWPPRA. The CWPPRA provides annual Federal funding of approximately $30-35 million. Of this amount, $5 million is designated for planning efforts, while the funding available for construction, including the State's 25 percent cost share, is about $40 million. Funds were first made available in fiscal year 1992 and will continue to be available through 1999. The annual priority project lists that result from the Restoration Plan will contain those projects that maximize wetland benefits compared to costs, and are within annual funding limitations. Large-scale projects that exceed annual funding limitations are candidates for feasibility study with CWPPRA planning funds but may require construction funding under other agency programs. It is possible that large-scale projects that exceed annual funding limitations could be phased-in over multiple years.

Projects would produce both beneficial and negative effects and divergent segments of the public will view the effects differently. In this EIS, the potential effects of the different types of proposed projects on identified significant resources are discussed. A resource is considered significant if it has been identified as such during public meetings held for the CWPPRA; if it is identified as significant in the laws or regulations of a public agency; or if it is considered significant by the lead and cooperating agencies responsible for this report. Significant resources specifically addressed in this chapter include coastal marsh; cypress-tupelo swamp; submerged aquatic vegetation; wildlife resources; fisheries resources; threatened and endangered species; oyster leases; water quality; National wildlife refuges, state wildlife management areas and refuges, and National parks; property ownership and values; flood protection; navigation and other forms of transportation; recreation opportunities; cultural resources including National Register sites; and various socioeconomic resources.

The effects of individual projects will not be discussed due to the lack of detail available for the proposals and the programmatic nature of this EIS. Project descriptions along with some obvious effects and key issues are included in the Basin Reports' Chapters and appendices to the accompanying main report. This EIS will provide NEPA compliance for the CWPPRA Restoration Plan as a whole, but individual projects selected for implementation will each require specific compliance with NEPA and other environmental and regulatory laws, regulations, and policies.

One of the five Federal Task Force agencies must take a lead role in the planning and implementation of each project. Nearly all proposed projects would require an evaluation for compliance with Section 404(b) of the Clean Water Act since dredging or filling activities in wetlands would be involved. Some non-structural initiatives such as vegetative plantings may be covered under general or nationwide permits. The U.S. Army Corps of Engineers (USACE) administers the Section 404 permitting process with oversight provided by the Environmental Protection Agency (EPA); therefore, lead agencies would submit an application to the USACE to obtain a permit. The permitting process requires preparation of an EA to determine the effects of a proposed action. In the case of a project or group of related projects that could significantly affect the environment, an EIS may be necessary. The determination of whether an EIS is necessary would be made by the lead agency in consultation with the USACE and the EPA.

The USACE has served as author and coordinator of this EIS with cooperating agencies. This role does not obligate the USACE to issue applicable permits to other task force agencies that may be required to build CWPPRA projects or preclude the USACE from recommending modifications to CWPPRA projects sponsored by other agencies as necessary to achieve NEPA or regulatory compliance.

Lead Federal Task Force agencies would determine, through their own NEPA implementing procedures, whether to circulate EA's for their projects or whether to rely on the permitting process to accomplish required NEPA compliance. Any EIS's prepared for projects would be circulated for public comment. The public would also be given the opportunity to comment on proposed projects through widespread circulation of notices of permit application. In Louisiana, a Joint Public Notice is issued by the USACE, the Louisiana Department of Natural Resources (LDNR), and the Louisiana Department of Environmental Quality (LDEQ). The notice serves to advise the public that an application has been made for a permit issued in accordance with one or more of the following statutes: 1) the State and Local Coastal Resources Management Act of 1978, as amended (Coastal Use Permit) administered by the LDNR; 2) the Clean Water Act (Section 404 permit) administered by the USACE; 3) the Rivers and Harbors Act of 1899 (Section 10 permit) administered by the USACE; and 4) the Clean Water Act (Section 401, Water Quality Certification) administered by the LDEQ. The USACE District Engineer would be responsible for signing a Finding of No Significant Impact in the case of an EA or a Record of Decision for an EIS to conclude the NEPA compliance process.

NEPA compliance for projects with the USACE as the lead agency would be coordinated somewhat differently than those sponsored by other agencies. An EA or an EIS would be prepared by the USACE and widely circulated to elected officials, agencies, environmental groups, and other responsible and interested parties. A Section 404(b) evaluation would also be prepared by the New Orleans District, signed by the District Engineer, and circulated for public review and comment. The USACE would prepare a Consistency Determination for submittal to the LDNR in accordance with their Coastal Zone Management Program and an application would be made with the LDEQ for a Water Quality Certificate. A Coastal Use Permit and a Water Quality Certification would be necessary before construction could begin. The District Engineer would be responsible for signing the Finding of No Significant Impact upon completion of the public review process for an EA. For an EIS, the District Engineer or another responsible USACE official would sign a Record of Decision.

Individuals who wish receive notices of NEPA document availability or copies of NEPA documents prepared for CWPPRA projects should request to be included on the mailing list. Requests to be included on the mailing list should be directed to the EIS coordinator identified on the cover sheet of this EIS.

During feasibility study, design, and permitting stages, lead Task Force agencies will consult with the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the Louisiana Department of Wildlife and Fisheries (LDWF) as required by the Fish and Wildlife Coordination Act.

The individual projects selected for implementation under the Restoration Plan are expected to produce a net increase in emergent and/or submerged vegetation over those conditions that would occur without a project. There is some risk involved with these projects. Some of the proposed projects are unproven and actual results attained may not reach the level of success expected. Coastal wetland restoration projects do not have a long track record that can be analyzed to determine the best methods to use under various situations. To a large degree, the Restoration Plan will be implemented using the professional judgement of the scientists and engineers of the Task Force agencies, the academic community, and private contractors. Each of the projects will be monitored according to protocol developed by the Task Force. The results of this monitoring will be used to improve the planning of future projects.

Restoration of wetland habitats will not be realized without affecting the existing condition of the wetlands and possibly, developed areas. Even though the existing condition of the wetlands may not be the most productive or desirable, the users of these areas have grown accustomed to the present conditions and often oppose actions that would change the existing condition because they would be affected socially or economically. A prime example of this is saltwater intrusion in a historically fresh marsh area. The saltwater displaces or kills freshwater species but brings in desirable estuarine species like shrimp, crabs, and finfish. Converting such an area back to a fresher habitat to preserve and restore vegetation by means of a freshwater diversion project could reduce or displace populations of estuarine species and could be opposed by the users of these resources. The effects of projects on these user groups will have to be considered by agency decision makers.

2. ALTERNATIVES

2.1. NO ACTION/WITHOUT CWPPRA CONDITIONS

The CWPPRA provides for a comprehensive, coast-wide, interagency approach to wetland protection and restoration that is not provided for by other legislation or initiatives. With or without the CWPPRA, some funding will probably continue to be provided for research into the causes of wetland loss in Louisiana and for various, sometimes unrelated wetland projects. Some of the types of projects listed under Section 2.3, Alternatives Considered in Detail, would probably be implemented, but not in a timely fashion or at the funding level that the CWPPRA offers.

Prior to passage of the CWPPRA, the USACE and the other Federal agencies that comprise the Task Force, along with the State of Louisiana, had just completed a reconnaissance level report for the Louisiana Comprehensive Coastal Wetlands Study (Comprehensive Study). That study had been funded under the general Louisiana Coastal Area authority given to the USACE by Congressional resolutions passed in 1967. The Comprehensive Study was designed to determine the most cost-effective projects for preserving, restoring, and creating coastal wetlands. It was the predecessor to the CWPPRA. Cost sharing agreements between the USACE and the State of Louisiana for the second-phase, feasibility study process were being negotiated when the CWPPRA was passed. The State and USACE decided to discontinue work on the Comprehensive Study and concentrate efforts on implementation of the CWPPRA. If the CWPPRA had not been enacted, it is likely that the Comprehensive Study would have progressed. However, unlike the CWPPRA, the Comprehensive Study did not provide funding for construction of any projects. Specific Congressional authorization would have been required to implement any proposals under that authority. The Comprehensive Study could be reactivated if the State and USACE agree to resume the study process; however, the CWPPRA has eliminated the need for the Comprehensive Study at the present time.

The Comprehensive Study proposed the use of non-conventional benefit analyses like the Wetland Value Assessment developed later for the CWPPRA to prioritize projects. Normally, USACE's project proposals seeking Congressional approval for construction funding must be justified by producing excess economic benefits over costs. How the results of the Comprehensive Study would have been accepted by Congress and the Administration is obviously unknown. With funding for project implementation already approved and projects not having to compete with the myriad of other civil works projects submitted for funding, the CWPPRA offers an immediate response to the coastal wetland loss problem in Louisiana.

The Louisiana Coastal Wetlands Conservation and Restoration Program, established by Act 6 of the 1989 Louisiana Legislature, Second Extraordinary Session, provides for a trust fund to be used for planning and implementing coastal wetlands projects. This program has successfully implemented a variety of wetlands projects and has studied and identified numerous other projects to benefit coastal wetlands. The program is the State's counterpart to the CWPPRA and its funds are used to cost-share CWPPRA projects. Many of the projects contained in the First and Second Priority Projects Lists are also in the State's Coastal Wetlands Conservation and Restoration Plan and future lists will undoubtedly include other projects contained in the State program. Without the Federal funds provided by the CWPPRA, the State would bear an increased burden of funding coastal wetlands restoration projects, resulting in considerably less project implementation.

The Barataria-Terrebonne National Estuary Program, cost-shared between the EPA and the State of Louisiana, is identifying problems affecting these basins and developing potential solutions. The program deals with a variety of issues including point and non-point source pollution, waste-water treatment, development issues, and wetland issues. The program provides funding for studies and pilot projects.

The Lake Pontchartrain Basin Foundation, under a grant from the EPA, is developing a Comprehensive Management Plan for the Pontchartrain Basin. The draft Comprehensive Management Plan identifies the numerous problems in the basin, including wetland loss, and proposes solutions. However, no funding is provided to implement the solutions.

The Gulf of Mexico Program, also sponsored by the EPA, is a gulf-wide initiative with wide-ranging objectives. A database of information pertaining to the Gulf of Mexico and its coastal areas has been developed. Committees and sub-committees, composed of knowledgeable representatives from various government agencies, private industry, and the public meet to identify problems affecting the Gulf of Mexico and its coastal areas and propose solutions. Very limited funds are available for implementation of projects.

The Coastal America Program is a multi-agency initiative coordinated by the President's Council on Environmental Quality. Its purpose is join the forces of Federal agencies with state, local, and private alliances to collaboratively address environmental problems along our Nation's shorelines. In particular, Coastal America focuses on three widespread problems: loss and degradation of habitat, pollution from non-point sources, and contaminated sediments. Funding for projects identified through this program must be provided through other existing authorities.

Two large-scale, freshwater diversion projects designed to benefit fish and wildlife resources are authorized for construction. The local cost-sharing agreement between the USACE and the State of Louisiana has been signed for the Davis Pond Freshwater Diversion and construction is set to begin in 1994 or 1995, after about one year of real estate acquisition. The project will restore favorable salinity regimes and benefit fish and wildlife resources in the Barataria Basin. The Bonnet Carré Freshwater Diversion would divert freshwater into the Pontchartrain Basin. Negotiations on the local cost-sharing agreement for that project are on-going.

Various other studies and programs are being funded by Federal and State agencies to document items such as coastal wetland loss and barrier island deterioration. Federal agencies have many sources of funding through existing laws and regulations to address specific topics concerning wetlands. For example, the North American Wetlands Conservation Act, administered by the U.S. Fish and Wildlife Service, provides a source of matching Federal grant funds for projects that help fulfill the goals of the North American Waterfowl Management Plan. The primary focus is on acquisition, restoration, enhancement, and management of wetland ecosystems and other habitat for migratory birds and other fish and wildlife. The Small Watershed Act (PL 83-566), administered by the Soil Conservation Service, provides funding for the restoration and protection of small watersheds under 250,000 acres. Programs such as these provide funding for the restoration and protection of both coastal and non-coastal wetlands throughout the entire United States. The CWPPRA on the other hand, focuses public resources exclusively on restoration and protection of coastal wetlands.

2.2. ALTERNATIVES ELIMINATED FROM CONSIDERATION

2.2.1. Plan Formulation Alternatives. According to the CWPPRA, the Restoration Plan shall "coordinate and integrate coastal wetlands restoration projects in a manner that will ensure the long-term conservation of the coastal wetlands of Louisiana". Through scoping and interagency meetings among Federal, state, and local agency representatives and the public, hundreds of projects have been proposed to address the wetland loss problem.

The CWPPRA legislatively mandates the use of cost-effectiveness as the criteria for identifying and prioritizing coastal wetland restoration projects. Alternatives to this process were not considered. For instance, alternatives for the Restoration Plan that would have favored a certain project type, such as sediment diversion, could have been formulated, but this approach would have been contrary to the legislation and would not have been a logical approach to the overall coastal wetlands loss problem. Only those types of project proposals that were obviously in conflict with the intended purpose of the CWPPRA were eliminated.

Alternative methods for prioritizing proposed projects could have been formulated. Unfortunately, no standard system exists for evaluating the habitat quality of coastal wetlands although several methods have been used for specific purposes. Therefore, a method for evaluating the effectiveness of projects was developed specifically for the Restoration Plan. This Wetland Value Assessment methodology is a habitat-based system for quantifying projected changes in wetland habitat quality and quantity for dependent fish and wildlife resources resulting from a proposed coastal wetland restoration project. The CWPPRA Task Force voted to use this methodology to evaluate and prioritize projects proposed for the priority projects lists. An abbreviated variation of the Wetland Value Assessment was used to prioritize all projects proposed for the Restoration Plan having enough detail to allow proper evaluation. Approximately one-half of the proposed projects were evaluated for potential benefits.

2.2.2. Project Type Alternatives. The CWPPRA specifically defines coastal wetlands restoration projects separately from coastal wetlands conservation projects. Coastal wetlands restoration projects are defined as "any technically feasible activity to create, restore, protect, or enhance coastal wetlands through sediment and freshwater diversion, water management, or other measures ...". Coastal wetlands conservation projects are defined as "obtaining of a real property interest in coastal lands or waters, ... for the long-term conservation of such lands and waters and the hydrology, water quality and fish and wildlife dependent thereon...". (A copy of the CWPPRA is provided as Exhibit 1 to the main report.) In other words, coastal wetlands conservation projects would involve obtaining easements or purchasing coastal lands specifically for their protection and management. Coastal wetlands conservation projects are specifically covered under Section 305 of the CWPPRA, while the Restoration Plan and its associated restoration projects are covered under Section 303. There are no projects proposed for the Restoration Plan at this time that would fit the definition of a coastal wetlands conservation project and therefore, that type of project is not covered in this EIS.

Regulation of developmental activities, which includes discharge of dredge or fill material, is also addressed by the CWPPRA. Under Section 304, the CWPPRA provides for funding the State of Louisiana to develop a Conservation Plan when requested by the Governor. The Conservation Plan is to include measures that the State shall take to achieve a goal of no net loss of wetlands as a result of development activities; a system to account for gains and losses of coastal wetlands for evaluating the attainment of no net loss; a program for public education on the need to conserve wetlands; and a program to encourage development and use of technologies that have negligible environmental impact. When the plan is complete and approved, the cost-share required of the State for CWPPRA project implementation will be reduced from 25 percent to 15 percent. The required agreement between the designated State agency (which has the responsibility for implementing and enforcing the Plan), the EPA (who administers the grants), the USACE, and the USFWS is being developed. Since regulation of developmental activities in wetlands is specifically covered by another section of the CWPPRA, it will not be considered as an alternative in this EIS which deals only with Section 303.

Proposals to help individuals or corporations mitigate for environmental damage caused by their projects with CWPPRA funds were eliminated. Also, proposals to move people out of developed areas so that areas can be restored to wetlands were eliminated. Other proposals that did not provide for protection, restoration, or creation of coastal wetlands were eliminated. A discussion of all project proposals submitted during Restoration Plan development is included in the Basin Reports' chapters and appendices of the main report.

Even though Louisiana has lost many thousands of acres of coastal marsh, there remains some extensive areas of marsh with very little interspersed open water (ponds). The habitat quality of these areas for many desirable aquatic and wildlife species could be improved by increasing the amount of interspersed ponds in the marsh; however, emergent marsh vegetation would have to be destroyed. This type of action, even though it may increase the habitat quality for some species, is considered counter to the mandate of the CWPPRA to preserve coastal wetlands, and will, therefore, not be considered.

Marsh burning is a practice commonly utilized in Louisiana to remove dead mats of marsh vegetation, especially saltmeadow cordgrass (*Spartina patens*), and encourage vegetative diversity. Benefits of marsh burning include increasing the quality of the habitat for some species of wildlife, facilitating human access to the marsh, and reducing the potential for devastation by marsh wildfires. Marsh fires can be classified as either wet or dry burns. Wet burns are conducted when the marsh soils are completely saturated and other factors, such as wind speed and direction, are favorable. By removing the dead, matted vegetation, the ground surface is exposed allowing the germination of desirable species like three-cornered grass (*Scirpus olneyi*) and leafy three-square (*Scirpus maritimus*), along with regeneration of saltmeadow cordgrass from root mats. The tender shoots of these species provide ideal forage for ducks, geese, swamp rabbits, muskrats, and other animals. Dry burns, on the other hand, have a high risk of destroying the organic soil material along with matted vegetation. Dry burns, unlike wet burns, would normally not be used by a responsible manager but may occur as a result of lightning or from irresponsible human action. By destroying the root mat that binds the soil together, dry burns increase water depth and increase the potential for marsh loss. Despite the aforementioned positive effects of proper marsh burning, it is not included as a alternative to be considered in detail because there is no evidence available to indicate that burning reduces the loss rate of marsh vegetation or builds new marsh. This practice alone is viewed primarily as vegetative enhancement for certain species of wildlife. However, elimination of marsh burning as a project type does not preclude the recommendation and use of burning within areas affected by CWPPRA projects under proper conditions and situations.

2.3. ALTERNATIVES CONSIDERED IN DETAIL

2.3.1. Introduction. The CWPPRA specifically directs the development of priority project lists and a Restoration Plan to incorporate such lists. The Task Force could have chosen any of a myriad number of ways to approach development of the Restoration Plan. Due to the enormity and complexity of the coastal wetlands loss problem in Louisiana, a system had to be developed to divide the area into manageable units. A hydrologic basin approach was adopted whereby a comprehensive plan for addressing coastal wetland loss was developed for each of coastal Louisiana's nine hydrologic basins (Plate 1 of the main report). Representatives from Task Force agencies ("Basin Captains") were selected and formed basin teams with other Task Force personnel. Basin teams also included representatives of the scientific community, local governmental agencies, and consulting contractors, but decisions regarding the basin plans were made by the Task Force agency representatives.

Basin Captains and teams were given direction by the Task Force to include all reasonable proposals and projects in the Restoration Plan regardless of cost. This direction made designation of mutually exclusive alternatives difficult. The Basin teams took information on basin problems and solutions, developed during strategic planning meetings conducted in 1991, and formulated basin plans. Several proposals were eliminated in every basin because they were not appropriate for CWPPRA funding or they duplicated other proposals. Some basin plans include a project or set of projects that meet the key objective(s) in the basin by solving the most pressing wetland loss problem(s). These projects are defined as critical. Supporting projects are included in the plan to address less critical objectives. The Plan at this point is a sort of catalog, listing critical and supporting projects, from which the most beneficial projects will be chosen for implementation.

Recognizing a general lack of basin-level alternatives, the methods and measures (project types) that could be implemented to restore, create, or protect coastal wetlands were used to form the basis for the discussion of alternatives in the EIS. Proposed projects have been grouped under thirteen major types: marsh management, hydrologic restoration, hydrologic management of impoundments, sediment diversion, freshwater diversion, outfall management, marsh creation (with dredged material), barrier island restoration, shoreline erosion control with structures, vegetative plantings, terracing, sediment trapping, and herbivore control. Specific proposals often combine more than one project type. For example, a large-scale hydrologic restoration project may include hydrologic restoration, marsh management of some sub-areas, shoreline erosion control with vegetative plantings or structures, and sediment trapping. Projects to demonstrate new technologies have also been placed under one of the thirteen categories.

The restoration plans for each basin are summarized in the main report and described in detail in its appendices. A very brief summary of projects and approaches proposed for each basin is presented in Section 3.4, Cumulative Impacts of Alternatives. The following sections describe the thirteen types of projects that have been proposed for the CWPPRA Restoration Plan.

2.3.2. Marsh Management. No universally accepted definition of marsh management exists. Cahoon and Groat (1990) offered one definition, Clark and Lehto (1991) reviewed several definitions, and Good and Clark (1993) cite a Louisiana statute that defines marsh management [Title 43:I.721(L) La. Admin. Code]. Regardless of the definition, the primary focus of marsh management is on water manipulation. Salinity, sediment load, flow velocity, and water levels are the attributes of water that are targeted for modification. The kinds, numbers, and vigor of plants and animals that comprise wetlands are sensitive to those same attributes. By attempting to selectively modify attributes, individually or in combinations, managers try to induce the desired plant and animal community responses. Proposed marsh management projects would likely be implemented in hydrologically altered areas where sediment and freshwater introduction is not feasible. In such cases, management is an attempt to assist marshes in countering the detrimental effects of mainly human-induced hydrologic changes.

Managers attempt to change selected hydrologic attributes either passively or actively. Passive management relies upon the use of non-adjustable structures. In contrast, active marsh management relies upon water control structures that can be reconfigured on an as-needed basis to effect one or more hydrologic attributes.

In order to effectively manage water levels and water flows, it is necessary to ensure the integrity of managed areas. New tidal connections can develop by the scouring action of water running across the marsh surface whether or not an area is managed. Natural levees, ridges, and lake rims surrounding proposed management areas would be evaluated for compatibility with structures and management plans proposed, and may have to be augmented by constructing low-level embankments. Existing canal banks may be gapped, reinforced, or otherwise modified, depending on hydrologic needs and conditions within the managed area.

The marshes of coastal Louisiana and South Carolina have been managed for similar reasons and in somewhat similar ways for many years. Improving conditions for waterfowl, furbearers, and recreational opportunities, as well as agriculture and fisheries production (to a much greater degree in South Carolina than Louisiana), have been and remain reasons to manage coastal marshes. In Louisiana, there is more emphasis on the role that marsh management can play in preserving and restoring emergent wetland vegetation.

DeVoe and Baughman's (1986) report of comparative studies of some managed and unmanaged South Carolina marshes are not directly applicable to all managed South Carolina marshes and are not directly applicable to Louisiana's marshes, managed or unmanaged. However, the South Carolina studies do provide some insight into the possible differences that may be expected between managed and unmanaged marshes in Louisiana.

2.3.2.1. Passive Management. The principal reason for choosing to passively manage marshes would likely be to enhance some attributes of fairly stable marshes by reducing tidal erosion, stabilizing water conditions, and enhancing conditions for some marsh-dwelling species. Several structures are used for passive management in Louisiana. Fixed-crest weirs, slotted weirs, rock weirs, plugs, levees, and trenasses (ditches) are the most common. These structures have both beneficial and adverse effects that are discussed in Section 3.

The traditional concept of passive marsh management is evolving into a relatively new concept called hydrologic restoration, to be discussed later. In contrast to passive marsh management, hydrologic restoration does not prevent or severely restrict the lowering of water levels below a certain elevation. Also, hydrologic restoration projects differ considerably from passive management because they minimally disrupt natural channels and do not prevent the sheet flow of water (and organisms) across the marsh during normal tidal stages as can be the case for passive management. Hydrologic restoration projects often contain the same type of structures used for passive marsh management, but sufficient vertical clearance is left in major tidal streams to allow for water exchange during periods when tidal levels are below normal. Neither of the two project types would prevent storm-driven high tides from entering or exiting protected marshes.

A number of First and Second priority project list projects contain plugs and weirs that can also be used for passive marsh management. However, these structures, when used for hydrologic restoration, would not be used to manipulate water levels, but rather to reduce and redirect water flows to other major waterways that would be left open to tidal exchange. Therefore, these projects are referred to as hydrologic restoration.

There are no specific projects envisioned at the present time for CWPPRA funding that are considered to be passive marsh management. As projects are developed for priority projects lists, some may be designed as passive management. However it is unlikely that this type of project will play a significant role in implementation of the CWPPRA. Passive marsh management is included as a project type only because of the possibility that during more detailed project development, situations may arise where passive management is determined to be an appropriate response to a wetland problem. Descriptions of the various structure types used for passive management that follow are applicable to hydrologic restoration as well.

2.3.2.1.1. Fixed-crest weirs. A fixed-crest weir is a low-level dam having a crest permanently set at some elevation relative to the surrounding marsh surface, usually about 6 inches lower. Most fixed-crest weirs constructed in Louisiana are of similar design and vary mainly in the method of construction and the materials used. Pilings are used to support the weir which may consist of wood, metal, or concrete sheet piling. Fill material is often deposited at the points where the weir ties into the channel bank to stabilize the weirs ends and prevent washing out.

Fixed-crest weirs were first used in Louisiana during the early 1940's. Weirs were and are constructed so that during low water periods they hold enough water in the affected area to facilitate access by boat, which also protects any submerged aquatic vegetation from drying out and, subsequently, perishing.

Nowadays, proposals to use only fixed-crest weirs to manage areas are extremely rare. Fixed-crest weirs are more often used in combinations with other kinds of water control structures to compliment management goals and objectives.

2.3.2.1.2. Slotted Weirs. Developed in the late 1980's, a slotted weir is similar to a fixed-crest weir in that it usually has a crest set six to 12 inches below marsh surface level, but is different in that it has an opening running vertically from the top to (or very near) the bottom of the weir. The slotted weir began as an experiment designed to alleviate the reduced fisheries access problem related to the use of conventional fixed-crest weirs. It has proven itself to be an improvement in this regard (Rogers, Herke and Knudsen, 1992). A recent variation is to build a slotted weir with a closable slot to provide for increased management options. Slotted weirs have also been perceived to be beneficial in enhancing sediment, nutrient, and water exchange, compared to fixed-crest weirs. Thus, the use of slotted weirs has increased in recent years but costs of construction and maintenance have somewhat curtailed its wider use.

2.3.2.1.3. Rock Weirs. A rock weir is a low-level dam composed of graded or mixed rock or concrete rip-rap across a channel with a crest height typically one-foot or more below the marsh surface elevation. An advantage to this type of weir over the fixed-crest and slotted weir designs is that rock can be added or removed if necessary to vary the height of the weir. Use of rock weirs is limited to areas with soils capable of supporting these heavy structures.

2.3.2.1.4. Plugs. A plug is a permanent barrier constructed across a channel to obstruct all water flow. Unlike weirs, plugs extend above water level and do not permit normal tides to flow in or out of the managed system. Plugs are typically installed only on man-made channels, but could be installed on small tidal openings that have developed in recent times due to scour or erosion. They can also be used to shunt water to other areas. No projects are proposed for the Restoration Plan that would involve completely closing off an area to tidal influence with plugs, although plugs are proposed for some projects to reduce the numbers of tidal openings or to redirect water flows to other structures.

2.3.2.1.5. Trenasses. A trenasse, also known as a level ditch, is a shallow ditch dug in a marsh. Originally, their purpose was to facilitate access into isolated marsh areas for trapping and hunting. Today they are used in some marsh management plans to more efficiently move water to or away from water control structures, to direct fresh water into a management area, or to provide proper water distribution.

2.3.2.2. Active Management. The reasons for choosing to actively manage marshes under the CWPPRA are to induce and invigorate the growth of emergent marsh and submerged aquatic plant species. Significantly more management capability is acquired, relative to passive management, when the amount, timing, quality (salinity) of water and sediment moving into and out of managed areas, can be controlled by manipulating water control structures. Active management structures can be configured to halt all water exchange when appropriate. They can also be configured to allow unhindered water exchange through the structures. Usually, they are configured to dampen exchange rates and volumes.

Active management provides the manager with expanded potential to create conditions that are conducive to: 1) inducing emergent marsh plants to grow on substrates that would otherwise be covered by shallow water; 2) inducing or invigorating the growth of submerged aquatic vegetation in open water areas; and 3) invigorating the growth of existing emergent marsh plants. To achieve these responses, managers typically select to install combinations of fixed-crest weirs, variable-crest weirs, and flap-gated culverts. There are many variations of the above listed structure types. In recent years, permits for structural management have often required that flap-gated, variable-crest structures include a vertical slot in their variable crest portions. Clark and Hartman (1990) noted that active management structures can be used in various combinations which determine the degree of effectiveness as well as degree of impact.

Which structures are to be located where, and operated according to what schedule, is determined on a case-by-case basis. Pumps can also be used but their use is more appropriate for existing impoundments, something different than active management. In Louisiana, operation of water control structures associated with active marsh management projects can have as many as three phases (Clark and Lehto, 1991; Paille, 1993). Phase 1 is the draw-down phase. Phase 2 is the water level maintenance phase. Phase 3 is the fresh water and sediment input phase. Freshwater and sediment sources frequently are not available and therefore phase 3 operations have limited applicability and documentation.

Phase 1 typically occurs during the spring and early summer months of every third year, but can be conducted more frequently. During phase 1, water control structures are configured to discharge water and preclude the entry of all water except rainfall. The goal is to sustain water levels below normal tidal level. The desired responses are the growth of vegetation on exposed substrates (mudflats and water bottoms), invigorated growth of existing marsh plants (both of the root mats and shoots), and initiation or invigoration of submerged aquatic vegetation in any remaining open water areas. Under favorable meteorological and hydrological conditions, these responses can be achieved by: 1) setting the crests of variable structures from 1 to 2 feet below marsh level; and 2) setting some or all flap-gates to discharge water and allow only rainwater to enter the managed area. Water is, therefore, removed from the managed area by gravity flow whenever a favorable head differential exists. Frequently, the timing and amount of rainfall, combined with high water levels outside of the managed areas, can preclude drawdowns sufficient to expose shallow water bottoms.

Phase 2 immediately follows phase 1. Phase 2 is in effect for the remainder of the year or unless a phase 3 operation is undertaken. Phase 2 goals are to sustain water levels within a suitable range, to protect against stressful conditions (rising salinity and water levels), and to maintain as much exchange with the estuary as possible without compromising the management effort. The primary response is the continued growth of marsh and submerged aquatic plant species. Another desired response, partly dependent upon achieving the primary response, is to increase furbearer population densities and/or to encourage overwintering waterfowl to use the area. These responses can be attained, under favorable meteorological and hydrological conditions, by setting variable weir crest elevations to about six inches below marsh surface elevation and by locking flap-gated structures open. Tidal exchange may be discontinued when salinity or water levels approach stressful levels. During waterfowl and trapping seasons, weir crest elevations are usually raised again (typically up to at least marsh level) to insure that sufficient water depth is maintained for hunter and trapper access and to enhance habitat for overwintering waterfowl.

A recent innovation, implemented on a limited basis during the last several years, is the inclusion of a flow-through phase (phase 3). Phase 3 operations can range from simple freshwater introduction to more complicated flow-through operations. The goal of phase 3 is to get fresh water, nutrients, and/or sediments into the managed area. The desired responses are the invigorated growth of rooted marsh plant species and sediment retention. Fresh water, with suspended sediments and nutrients, when and where available, is encouraged to flow into a management area through one or more structures. Excess freshwater, less much of its nutrient and sediment loads, exits the managed area through structures on the downstream side. The fresh water flow-through helps to keep soil salt levels below stressful or toxic levels. Phase 3 can be employed from spring to early summer during years when draw-downs are not attempted.

2.3.3. Hydrologic Restoration. Hydrologic restoration differs from marsh management in one principal fashion. It is employed to reduce and redirect tidal water flows whereas marsh management is employed to control water levels and water flows. Hydrologic restoration is used to restore, to the extent practical, historic water flow patterns and water and salinity regimes in wetlands that have been subjected to increased tidal action from canal dredging, erosion, and channel widening, by reducing and redirecting water flows. Projects would somewhat dampen water level fluctuations within restoration areas, but tidal flows would not be manipulated or restricted from rising above or dropping below certain levels as in the case of active marsh management projects.

Hydrologic restoration projects consist of structures such as plugs and weirs used to reduce flows in canals dredged through or into a wetland area and redirect water flows to naturally occurring bayous and streams. In many proposals, natural waterways leading into a wetland area may also be reduced in size to lessen tidal scour and redirect water flow, especially if these waterways have eroded and increased in size during recent times. Occasionally, small tidal streams that have developed recently due to erosion or marsh deterioration may have to be closed with plugs, but larger, historically-active bayous would not be closed. Structures on major water routes would typically have sufficient vertical clearance below the water surface to provide access for both vessel traffic and migrating aquatic species. Additional project features may include degrading or gapping canal banks to restore sheet flow across wetlands or rebuilding natural levees and canal banks to control water flows. Projects may also include shoreline stabilization and vegetative plantings. Hydrologic restoration does not require construction of levees to isolate the restoration site from surrounding wetlands. Hydrologic restoration is passive; no manipulation of structures or other variables is involved. The Lower Bayou LaCache (TE-19) and Jonathan Davis Wetlands (PBA-35) projects from the First and Second Priority Project Lists, respectively, are good examples of hydrologic restoration projects.

Durable structures are required to reduce water flows in scoured and eroded channels. Structures must be able to withstand tidal forces and be constructible on the poor soil conditions common in coastal Louisiana. Rock weirs with boat bays appear to be the preferred structure type based on proposals submitted for the Restoration Plan. These structures are very similar to the rock weirs described for passive marsh management but differ in their top elevation. The entire width of the weir, except for where it ties into the channel bank, may be well below the average water surface and there is normally a lower section in the center of the weir (boat bay) for passage of boat traffic. Consequently, water flows are not restricted nearly as much as by a rock weir constructed for passive marsh management. Rock weirs, because of their weight, are limited to areas where the soil is capable of supporting them.

Hydrologic restoration projects can range in size from small areas of several hundred acres to large-scale projects that would alter the hydrology of major portions of hydrologic basins. For example, the Central Basin Tidal Drag Enhancement project for the Barataria Basin (XBA-63) would attempt to reduce tidal flows in the upper half of the entire basin.

Projects that would maximize the beneficial use of sediment-laden waters found in the GIWW in the Terrebonne, Atchafalaya, and Teche/Vermilion Basins are also considered to be hydrologic restoration although they typically contain features of freshwater diversion, shoreline protection, and hydrologic restoration projects. The turbid water would be allowed to flow into deteriorated marshes on either side of the GIWW and distribution of water in the marsh would be controlled using hydrologic restoration techniques. Areas to be benefitted from these projects may or may not have problems related to salt water intrusion but do have sediment deficit problems.

2.3.4. Hydrologic Management of Impoundments. This type of project would be used to restore and enhance wetland functions in areas that have been impounded by levees and have undergone either subsidence and deterioration to open water or draining and conversion to non-wetland habitat. Previously leveed areas that have lost either part or all of their wetland functions would be restored, as much as feasible, to a viable marsh system by improved hydrologic control. Such areas have typically been impounded for reasons other than wetland preservation or restoration. Some of these impounded areas have been drained and converted to non-wetlands while others suffer from chronic high water levels. Water control structures and their operational scheme would have to be custom designed for individual project areas and may include pumps and other water control structures typically used for active marsh management. The end product of such projects would indeed be a form of management and a valid argument could be made to include this type of project under the marsh management category. The major difference between these projects and more typical marsh management lies in the existing condition of the impounded areas. The arguments and controversy surrounding the effect of marsh management on estuarine fisheries access are not applicable to impoundments since estuarine species are currently excluded or severely restricted from using these areas. Therefore, even though there are only a limited number of these projects proposed, they should be distinguished from marsh management due to their lack of additional impact on estuarine fisheries resources.

In typical examples like the Bayou Sauvage Projects (XPO-52A and XPO-52B) from the First and Second Priority Project Lists, the project area has been enclosed within a hurricane protection levee system and existing water level control structures (flap-gated culverts) are not effective in maintaining desirable wetland habitat. Past land use practices have caused the area to subside. Re-connection of the area to the tidal system is not feasible because the soil surface elevation is too low to support emergent vegetation and the hurricane protection system would be compromised. A system of pumps and other water control structures would be used to regulate water levels and to optimize wetland functions.

2.3.5. Sediment Diversion. One of the major causes of coastal wetland loss, especially in the Louisiana Deltaic Plain, is the deprivation of riverine sediments as a result of levee systems constructed along the Mississippi River and its tributaries for flood control. The primary purpose of sediment diversions is to create wetlands by re-establishing natural sediment deposition. Sediment diversions have the potential to create, restore, and preserve large areas of marsh, however the total amount of water and sediments in Louisiana's river systems is limited. The location and size of both freshwater and sediment diversions must be optimized to achieve the greatest benefit and minimize adverse impacts. One of the priority planning studies to be undertaken for implementation of the Restoration Plan will determine the sediment and freshwater budget of the Mississippi River below the Old River Control Structure.

Sediment and freshwater diversions attempt to mimic the natural over-bank flows that occurred annually during high river stages, typically in the spring of the year, before humans harnessed the lower Mississippi and Atchafalaya Rivers. Sediment diversion is as close as we can get to reestablishing the natural process of riverbank overflow given the existing development in coastal Louisiana. The Mississippi River built most of the coastal wetlands in Louisiana and in it lies the best hope for restoring wetlands that have been lost in recent decades. Protective measures can, in many instances, reduce or stop the loss, but generally cannot restore large areas of wetlands.

Sediment diversion would involve breaching the natural bank or levee of the Mississippi or Atchafalaya River, or their passes, and allowing sediments and freshwater to flow into shallow open water or deteriorated wetlands. The only existing man-made sediment diversions are the small-scale crevasses located along the passes in the active Mississippi River Delta. They have been moderately to very successful in restoring marsh and scrub/shrub wetland habitats. These small-scale diversions have been nothing more than cuts dredged through the natural banks to allow sediment and water to flow into adjacent shallow ponds and lagoons. Large-scale diversions along the main stem of a river would require much more detailed engineering and design to determine the optimal site location, angle-of-cut, depth-of-cut, scour possibilities, and effects on a variety of socioeconomic uses and environmental resources.

The West Bay Sediment Diversion project (FMR-3) included on the First Priority Project List is a large-scale sediment diversion directly from the Mississippi River below Venice at approximately river mile 4.5 above Head of Passes. As proposed, the project would involve cutting a gap in the west bank of the river, below the terminus of the mainline Mississippi River levee system, to allow river water and sediment to flow into an area of largely shallow open water. This site was found to provide the greatest economic benefit out of a number of sediment diversion sites evaluated during a study conducted by the USACE and the LDNR. Additional large-scale sediment diversions are included in the Restoration Plan for sites on both sides of the Mississippi River below New Orleans including Myrtle Grove and Homeplace on the west side and Bohemia and Benny's Bay on the east side. The Mississippi River Channel Relocation project (PMR-6) would divert up to 70 percent of the Mississippi River's flow through a new channel into either the Breton Sound or Barataria Basin. Obviously, this project would require extensive engineering and design work along with a thorough evaluation of its environmental effects and socioeconomic impacts before it could be constructed.

Special features of this type of project may include sediment retention devices and various techniques to manage wetlands nourished and created in the area influenced by the diversion. Large-scale sediment diversions, which are designed to take a percentage of the river's sediment bedload, require a deep excavation and a gradually upward sloping channel to move the sediment into the wetland creation area. Periodic dredging of the distributary passes may be necessary in order to keep the diversions operating effectively.

The Atchafalaya River, a major distributary of the Mississippi River, and the Atchafalaya Basin Floodway system are a primary element of the Mississippi River and Tributaries flood control system for southeast Louisiana. The Atchafalaya, which is apportioned 30 percent of the combined Red and Mississippi Rivers' average annual flow through control structures at Old River, has filled in large parts of its interior basin since the 1950's and has developed an extensive active delta in Atchafalaya Bay since the early 1970's. Wetlands form in this area because of the relatively shallow waters of Atchafalaya Bay and the consolidated nature of underlying sediments as compared to the Mississippi River Delta. The Big Island Sediment Mining and Atchafalaya Sediment Delivery projects (XAT-7 and PAT-2) from the Second Priority Project List are examples of the types of sediment diversion projects possible in the active Atchafalaya Delta. They are similar to, but larger than, the small-scale sediment diversion projects that have been implemented in the Mississippi Delta.

Another type of sediment diversion, designed to enrich the flow of existing and planned freshwater diversions with sediments, has been proposed. Conceptually, sediment enrichment would be accomplished in either of two ways, but would only be applicable to freshwater diversions from the Mississippi River. First, a hydraulic cutterhead dredge operating in the Mississippi River in the vicinity of the freshwater diversion could discharge dredged material just upstream of the freshwater diversion inflow channel. In theory, heavy sands would quickly settle to the bottom while lighter silts and clays would be carried through the diversion structure and discharged into the estuarine system to combat subsidence. Another method that has been proposed for freshwater diversion siphons is to extend the diversion's inflow pipes so that they pull water from a lower depth which may have a higher concentration of suspended sediment. The Siphoned Sediment Enrichment of Freshwater Diversions (XBA-67) project for the Barataria Basin is an example of this type of sediment diversion.

In the western part of the state, and some other areas isolated from the major rivers, sediment is not available to implement projects of this type. In these areas, the growth and maintenance of marshes is more dependent on organic accumulations (Nyman et al., 1993; Gagliano and Roberts, 1987) and the use of other project types becomes more important.

2.3.6. Freshwater Diversion. Freshwater diversions and sediment diversions differ in their intended purpose and in the type of excavation or structure required for diversion. Several small-scale (100-2000 cubic feet per second) and two large-scale (8,000-12,000 cubic feet per second) freshwater diversion structures (Caernarvon and Bayou Lamoque structures) have been constructed along the Mississippi River south of New Orleans. The small-scale structures are siphons that run over the river levees. The large-scale structures are steel and concrete culverts with closure gates that pass through the river levees. These diversions were built mainly to benefit fish and wildlife resources and vegetated wetlands by restoring favorable salinity levels in the affected estuaries. In addition to these structures, overflow weirs have been constructed along the armored banks of the Mississippi River, below the terminus of the mainline levee system. These weirs were installed as mitigation for rock dikes placed along the river banks. All of these structures have the potential to reduce the loss of wetlands, especially marsh, by reducing saltwater intrusion and adding nutrients from the Mississippi River. Considerable volumes of suspended sediments would also be diverted along with fresh water. At Caernarvon, several hundred acres of marsh are expected to develop in a large, shallow area of open water near its outfall over the next 50 years. Any development of marsh from freshwater diversions would likely be very near the diversion outfall and would depend on the configuration of the outfall area and outfall management features.

Two more freshwater diversions, the Bonnet Carré and Davis Pond diversions, have been authorized for construction through other authorities and are in the advanced design stage. The potential exists for additional freshwater diversions along the Mississippi River and its distributaries, including the Atchafalaya River, Bayou Lafourche, and other rivers in the coastal plain. There is a point at which diversion of too much water from the Mississippi River will begin to seriously effect the ability of the USACE to maintain the navigation channel. This critical point has been estimated at 100,000 cubic feet per second (CFS) measured during average high river stage. The total possible discharge of all structures currently authorized for construction and those already constructed is about 65,000 cfs, however it is unlikely that all structures would ever be operated at design capacity simultaneously.

Nevertheless, new proposals for freshwater and sediment diversions will have to be evaluated for their effects on navigation. The study referred to previously under sediment diversion will determine the freshwater and sediment budget of lower Mississippi River.

Freshwater diversions can be operated to mimic the natural over-bank river flows normally associated with spring flooding. They work with the natural process of marsh maintenance by supplying fine grained suspended sediments to counter the natural subsidence and compaction of alluvial deposits. They also provide nutrients that cause invigorated plant growth. Increased organic deposition stemming from invigorated plant growth also contributes to the vertical accretion process. Freshwater diversions can maintain and invigorate existing wetlands, but generally would not restore wetlands in areas of existing open water to any significant degree. Suspended sediments that would drop out of the diverted waters near diversion sites would, over time, form some vegetated areas, but the only real hope for restoring significant areas of coastal marsh and swamp that have been lost to open water is sediment diversions which capture a portion of the river's bedload. Sizable areas of marsh could be developed through the use of dredged material, but that method is costly and very inefficient except when dredged sediments are available in close proximity to a potential marsh creation site.

A very different type of freshwater diversion is possible in Chenier Plain. Water levels in the upper Mermentau Basin (Lakes Subbasin) are normally held higher than mean sea level, mainly to conserve fresh water for agricultural and navigational uses. Effects of saltwater intrusion in the eastern part of the Calcasieu/Sabine Basin and the lower Mermentau Basin could be lessened by diversion of excess freshwater from the northern part of the Mermentau Basin. Additionally, reducing water levels in the Lakes Subbasin would help reduce shoreline erosion occurring around Grand and White Lakes and would also reduce the stress on vegetation from chronically high water levels. The total amount of water available for diversion must be balanced with agricultural, navigational, and other competing interests in the basin. An impediment to diversions from the Lakes Subbasin is the fact that water levels in potential outfall areas are sometimes higher than those within the subbasin. Some freshwater diversion projects have already been constructed by local interests and the State, and more are proposed. The Pecan Island Diversion (ME-1), already constructed by the State, is a prime example of this type of project.

Most freshwater diversions consist of a structure through which flows can be regulated depending on the existing salinity regime of the outfall area. During wet periods when ambient conditions in the target area are fresher than normal, flows can be restricted to prevent unacceptable adverse impacts to estuarine fish species or to prevent inundating the outflow area. The constructed and envisioned sediment diversions do not have a mechanism for regulating flows, except for filling or partially filling the diversion sites with dredged or fill material.

2.3.7. Outfall Management. Outfall management is a form of hydrologic restoration but it will be discussed separately because it is dependent upon a freshwater source and because its intended purpose is considerably different. The purpose of outfall management is to make optimum use of freshwater, nutrients, and sediments conveyed through a freshwater or sediment diversion by managing water flow through a specified outfall area. These projects reduce channelized flows and route the diverted flows across marshes or through shallow water areas instead of through larger channels so that suspended sediments are deposited and marshes are nourished and created. Outfall management has been proposed for all existing and proposed freshwater diversions from the Mississippi River, because outfall management was not provided when the projects were funded. Project features are very similar to those used for hydrologic restoration. These features may include degrading or rebuilding canal banks as appropriate, plugging or filling canals, reducing the cross-section of natural tidal waterways, and using hay bales, brush fences, or low-level dikes to direct water flow and trap sediment. No outfall management projects have yet been constructed. The Caernarvon Outfall Management project (BS-3b) included on the Second Priority Project List is a good example of an outfall management proposal.

2.3.8. Marsh Creation with Dredged Material. This type of project would utilize material dredged specifically for marsh creation or material dredged during maintenance of navigation channels to create marsh or nourish existing deteriorated marsh. The conventional method is for a hydraulic cutterhead dredge to remove material (sand, silt, and clay) from the bottom of a water body and pump the material through either a floating or submerged pipeline and discharge the material into either a shallow open water area or into a deteriorated marsh. A typical deteriorated marsh is an area of mostly shallow water with some interspersed emergent vegetation that is dying due to subsidence or erosion.

Care must be taken to deposit the dredged material so that after settling, the elevation is conducive to the growth of marsh plant species. Vegetative plantings are sometimes used to establish desirable wetland species on the newly deposited material, although rapid colonization and spread of vegetation usually occurs naturally on material of proper elevation.

Dredged material may be excavated specifically for marsh creation efforts from nearby water bottoms or may come from maintained navigation channels. When marsh creation is accomplished with material dredged from a navigation channel, the CWPPRA could provide funds for the incremental cost of creating marsh above the cost of disposing the material in the least costly, environmentally acceptable manner. The USACE, New Orleans District uses material dredged from navigation channels for wetland development when this method of disposal is appropriate and when the cost of doing so does not substantially increase the cost of maintenance dredging. In many cases, no suitable marsh creation or nourishment sites are located near the dredging sites and an additional source of funding is necessary to utilize the material in a beneficial manner.

Proposals have been made to use unconventional technologies and materials for marsh creation. Some of these proposals are controversial. There are proposals to use abandoned oil and gas pipelines for transporting material to distant sites, innovative spraying techniques to spread dredged material evenly over shallow water or deteriorated marsh, and spent bauxite (locally referred to as "red mud") for building substrate to an elevation suitable for colonization by marsh plant species. While red mud is mined, not dredged, the method by which it would be deposited for marsh creation would be similar to methods used for dredged material. These types of proposals would probably be designated as demonstration projects that are specifically addressed in the CWPPRA. The Red Mud Wetlands Restoration project (XTE-43) is a proposed demonstration project that would utilize red mud generated at a Kaiser aluminum plant near Gramercy, Louisiana to build marsh substrate. The project site is located on vacant land st the plant site. This demonstration is designed to determine if red mud would be suitable for larger-scale restoration efforts. There are many questions to be answered about the possible toxic effects of this foreign material on the wetland ecosystem. The Falgout Canal South project (TE-20) is a proposed demonstration of a prototype for a regional system to mine, deliver, and distribute river sediment via pipelines and spray nozzle application. The Sediment Conveyance Demonstration project (XTE-66) would attempt to use gravity flow and pipelines to distribute sediment into subsided marsh areas.

2.3.9. Barrier Island Restoration. This type of project is similar to marsh creation with dredged material, but differs in several ways. The main purpose of this type of proposal is to restore barrier islands, not only for the marsh and dune habitat on the islands, but also for the protection that they may provide to the marsh and estuarine ecosystem landward of the islands. The extent to which barrier islands protect mainland marsh varies according to the proximity of the islands to the mainland marsh and the depth and extent of intervening bays. The actual amount of protection that would be provided to interior marshes by specific barrier island restoration projects is largely unknown and is the subject of considerable debate among the Task Force agencies. Barrier island restoration involves the pumping of sand, from either offshore deposits or from deposits in the bays behind the islands, into previously constructed containment cells on deteriorated barrier islands. The habitat created is a combination of dune, back-dune scrub/shrub and mangrove, and marsh. The dune habitat is essential to the integrity of barrier islands because it protects the marsh areas on the inland side of the islands from direct wave attack during storm events as well as providing material for the natural landward migration typical of many barrier islands.

Proposals have also been made to protect the barrier islands of the Barataria Basin with hard structures such as detached breakwaters (XBA-1A1 through XBA-1E1).

These projects are addressed under the following category of projects; shoreline erosion control with structures.

2.3.10. Shoreline Erosion Control with Structures. Various types of materials and structures can be used for shoreline erosion protection. The material most commonly used in Louisiana is quarried rock of various sizes. Sometimes filter fabric, geotextile material, and shell or other lightweight aggregate is used as a base for the rock. Other materials that have been used are shell, used tires, and timbers. In some cases where wave energy is low to moderate, material dredged from water bottoms adjacent to the eroding shoreline is used to provide stability to the shoreline. In such a case, vegetative plantings may be used to stabilize the newly deposited material. Structures may be built on the existing shoreline to prevent further erosion or may be built out from the shoreline to break waves and trap sediments so that marsh can develop between the shoreline and the structure. Structures built out from the shoreline (i.e. breakwaters) are preferred over structures on the shoreline if soil conditions will support it and if the sediment supply is sufficient to cause deposition behind the structures.

The use of hard structures along the open gulf shoreline, including barrier islands, is controversial. Hard structures such as jetties and groins can interrupt the littoral drift of sand causing deposition and shoreline building in some areas while causing sediment starvation and erosion in other areas. Any proposal to use hard structures along the gulf shoreline would require prior site-specific study to determine if the proposed structures would be suitable for the situation. Offshore segmented breakwaters placed along the gulf shoreline at Holly Beach in southwest Louisiana by the State of Louisiana are apparently performing well. Structural shoreline protection along inland waterways, lakes, and bays is not nearly as controversial because there is generally no littoral drift process in these inland areas and there is minimal potential for negative effects associated with sediment starvation in nearby areas.

2.3.11. Vegetative Plantings. The most commonly used species for erosion control in coastal Louisiana is smooth cordgrass (*Spartina alterniflora*) also known as saltmarsh cordgrass or oystergrass. It is the dominant plant species of saline marshes in Louisiana. Saltmarsh cordgrass, once established, can withstand moderate wave energy and prolonged flooding. It works especially well when introduced in areas where saltwater has intruded into previously fresher areas and saltmarsh cordgrass has not yet established naturally. This plant can also grow fairly well in freshwater conditions due to its extremely broad salinity range. The preferred planting site for this species is the intertidal zone. This plant does not perform well on the deep organic soils common to most fresh and intermediate marshes, which also tend to have very low tidal ranges. Giant cutgrass (*Zizaniopsis miliacea*), seashore paspalum (*Paspalum vaginatum*), and California bulrush (*Scirpus californicus*) are desirable species commonly recommended for shoreline protection in fresh and intermediate marsh areas.

Giant cutgrass is tolerant of standing water and may also be introduced into areas of shallow water. This species can sometimes thrive in areas where the vegetation occurring previously was not able to cope with high water levels. In some areas, temporary silt screens or wave dampening devices would be used to protect the new plants until they become established and protection of newly planted sprigs is sometimes necessary to prevent grazing by nutria.

Both private enterprise and government agencies are working to develop strains of marsh grasses that have desirable characteristics such as accelerated growth, resistance to prolonged flooding, and resistance to high salinity. Other species such as black willow (*Salix nigra*) and common reed (*Phragmites australis*) are sometimes used when conditions are not suitable for saltmarsh cordgrass such as insufficient salinity levels or highly organic soils. Although no introduced or exotic species are presently being used for shoreline protection, it has been suggested that the use of the Asian grass species known as vetiver (*Vetiveria sp.*) be investigated.

The Soil Conservation Service (SCS), LDNR, and other agencies and local interests have had considerable success with vegetative plantings in Louisiana. Much has been learned about the conditions necessary for various plant species. The Vegetative Plantings Demonstration Project from the First Priority Project List is an example of this type of project.

2.3.12. Terracing. This method of wetland creation uses a barge-mounted crane or dragline to dredge material from the bottom of shallow open water areas and deposit the material in rows or terraces forming geometric patterns with gaps to allow water flow. Marsh vegetation is planted on the terraces and both the terraces and vegetation help reduce fetch thereby minimizing turbidity and shoreline erosion on windward sides of open water areas from wind-generated waves. Although the acreage of marsh created by this method is relatively low compared to some other project types, the shallow, calm water between the terraces provides an ideal area for the growth of aquatic vegetation and the terraces can reduce the erosive force of wave action on nearby natural marshes. A considerable increase in marsh edge or marsh-water interface, which is very desirable habitat for aquatic species and wading birds, also results from terracing.

Only one terracing project has been constructed to date. It was financed jointly by the EPA and the State of Louisiana and is located on the Sabine National Wildlife Refuge near West Cove in Calcasieu Lake. In this project, the terraces were arranged in an open checkerboard pattern. The project is functioning as designed, providing shallow marsh edge habitat for aquatic species, nesting and feeding sites for birds, and reducing turbidity levels to the benefit of submerged aquatic vegetation.

2.3.13. Sediment Trapping. A commonly used method of sediment trapping in south Louisiana employs discarded Christmas trees that are set in cribs made of timbers and screening material. These devices slow water currents and allow sediments to drop out of the water column. Often marsh species are planted in the protected areas formed by the cribs if water depth or soil elevation is suitable. Sediment deposition will build the substrate in and around the cribs to an elevation suitable for colonization of the area by marsh plant species. Other devices used for sediment trapping include fences made with timbers and any of a number of different screening materials, set perpendicular to water flows.

Sediment trapping works best in areas where there is an abundance of sediments being transported by flowing water. Sediments suspended in the water settle on the downstream side of the fences and marsh plant species colonize the mud flats that develop when suitable build-up has occurred. This type of sediment trap has been used successfully in shallow ponds of the active Mississippi River Delta and may also be beneficial in emerging deltas in Atchafalaya Bay. An example of a sediment trapping project is the Pass a Loutre Sediment Fencing project (MR-2) proposed for the Second Priority Project List. Although not specifically referred to as sediment trapping devices, the structures described under Shoreline Erosion Control with Structures can act as sediment traps when they are set out from the shoreline and constructed as a segmented breakwater.

These projects can restore marsh in shallow open water areas. Success hinges on a variety of factors that must be taken into consideration when designing a project. Important factors to be considered are; the amount of sediment being transported through the project area, the proper alignment of the structure to maximize sediment capture, the proper position of the project, the existing water depths, subsidence rates, and overall geography and geology of the area.

2.3.14. Herbivore Control. Scientific evidence indicates that, under certain conditions, grazing of marsh and cypress/tupelo swamp by nutria (*Myocaster coypus*) and muskrat (*Ondatra zibethicus*) is having a negative effect on these habitats. Muskrat "eatouts" are easy to identify by large numbers of muskrat dens and denuded areas of marsh, whereas effects of nutria grazing are less obvious. While effects are not as obvious, it appears that high concentrations of nutria cause a long-term stress on marsh by continuously grazing selected species, uprooting other species in search of preferred roots, and grazing the fresh shoots of other species. Nutria are non-native animals introduced into the United States from South America. Many people believe that nutria are causing a much greater problem than muskrats because they are much more numerous, they occur in a greater range of habitats, and their eating habits are less specific. Normally, high muskrat concentrations are found only in intermediate and brackish marshes containing abundant amounts of three-cornered grass (*Scirpus olneyi*). Geese have also been known to cause "eatouts" in marshes that have resulted in conversion to open water, however this problem appears to have declined in recent years and is not of serious concern. The problem of overgrazing by nutria especially and muskrat to a lesser degree, is considered a very serious threat to marshes and cypress swamp regeneration efforts. These furbearing animals were, until the early 1980's, a valuable resource, harvested in great quantities for their pelts. The commercial harvest of these animals helped keep their populations under control. The worldwide downturn in the fur industry has reduced the economic value of these animals, and the population of nutria, especially in the more susceptible Deltaic Plain, is apparently expanding rapidly.

The Louisiana Department of Wildlife and Fisheries (LDWF) has jurisdiction over resident fur and game animal harvest. The LDWF considers these species a resource and governs their taking by various laws on fur harvest. Changing the animal's status to a nuisance species is not being considered by the LDWF.

The LDWF and LDNR have developed a pilot trapping incentive program under the Louisiana Coastal Wetlands Conservation and Restoration Plan to encourage landowners and trappers to control overpopulation of nutria in selected target areas where damage to wetlands has been identified by LDWF. This program involves incentive payments to trappers harvesting animals from selected areas. The incentive payments are cost-shared between the State and landowners. CWPPRA funds could be utilized to supplement this effort and expand the potential to control overgrazing. There has been some discussion among the various agencies involved in the Restoration Plan effort concerning whether a trapping incentive program would be an appropriate use of CWPPRA funds. The proposal is actually a sort of a bounty and bounties often have not produced anticipated results. However, the problem with herbivores exists and no other methods of control have yet been offered as part of the CWPPRA Restoration Plan.

Herbivory control could be critical to the success of some vegetative planting efforts. Exclusion devices like fencing or screening has been shown to be effective in protecting newly planted grasses and cypress trees from predation by nutria. No specific projects are proposed for exclusion devices, however various methods of protection will probably be incorporated into many vegetative planting efforts, especially in known areas of high nutria populations.