SOCIOECONOMIC IMPACTS OF THE BROWN MARSH PHENOMENON

In Fulfillment of:
DNR Interagency Agreement No. 2512-01-14

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Report
(CEI# 23083)

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EXECUTIVE SUMMARY

During the record setting drought of 2000 vast areas of southern Louisiana marshes contained large areas of salt marsh grass die off. In the most severely affected areas the marsh grass, predominately *Spartina alterniflora*, was completely dead and the marsh looked brown or black when viewed from the air. While the exact causes are not yet known, the general consensus was that this “brown marsh” phenomenon (BMP) was closely associated with the unique combination of environmental conditions from 1998 to 1999, culminating in severe drought in the year 2000.

In this report, the potential socioeconomic impacts of the brown marsh phenomenon (BMP) in the parishes of St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines and St. Bernard (the "project area") are described. These potential impacts are presented and discussed using both an Environmental Assessment (EA) approach (Part One) and an Economics approach (Part Two); both approaches result in prediction and quantification of impacts.

From the Environmental Assessment (EA) perspective, potential impacts to the project area include loss of approximately 500,000 acres of salt marsh, loss of up to 500,000 acres of farm and crop lands, loss of approximately $415 million in tax revenues, and potential displacement of up to 800,000 residents, including a labor force of approximately 389,000 people.

From an economist's perspective, there are direct, indirect, and intangible benefits associated with a marsh. Direct economic benefits to salt marshes include estuary-dependant commercial industries, recreation and eco-tourism. Indirect economic benefits include water quality benefits and protection from storms or storm surge. Intangible benefits are primarily comprised of the benefits of the marshes on our culture and history.

To determine the impact of the BMP one must establish marsh value on a per-acre basis. To do so requires calculating the economic benefit of the marsh to the entire resource area then dividing the total marsh value by the acreage of the area, resulting in a per acre resource benefit value. There is however an inherent uncertainty in this calculation because the nature and extent of the biophysical links between marsh viability and the benefits discussed previously are uncertain, thus the value per acre range calculated in this report represents a conservative estimate of the value of salt marshes in the project area only. The financial impact calculations contained in this report represent the loss of salt marsh only; the inevitable impacts to the other marsh types subsequent to the salt marsh impacts are implied but neither addressed nor quantified in this report.

The resource area for this study is the six-parish project area, which contained approximately 1.8 million acres of marsh prior to the 1998-2000 salt marsh die off episode. Of this, approximately 500,000 acres were salt marsh. Calculating the cumulative lower and upper range annual marsh benefit values, $673,896,210 and $1,301,651,711 respectively, and dividing by the total acreage of salt marsh in the project area yielded a range in marsh value from $1,348 to $2,603 per acre.

DISCLAIMER

All interpretations and conclusions contained herein are based upon the most comprehensive dataset available for years prior to and including the BMP years of 1999-2000 and/or 2001, with the exception of the some of the hunting and fishing datasets used in Section 4. These conclusions are relevant only for salt marshes in the project parishes of St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines and St. Bernard. Although this research implies that other marsh types were also impacted by the BMP, these impacts are not specifically addressed nor are they quantified. While other social and economic factors may be relevant, only those specifically described in this report contribute to the interpretations, conclusions, and monetary values reported herein. The value range per acre of salt marsh as described in this report represents a conservative estimate of the value of an acre of salt marsh in the six-parish project area, based upon the parameters described.

ACKNOWLEDGEMENTS

Kimberly Barton prepared this report, with significant contribution from Gerald Morrissey. It was partially funded by the National Oceanic and Atmospheric Administration, United States Department of Commerce. The statements, findings, conclusions and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

INTRODUCTION

During the record setting drought of 2000, scientists conducting experiments and laypeople working in southern Louisiana marshes observed areas of wide spread marsh grass die off. In the most severely affected areas the marsh grass, predominately *Spartina alterniflora*, was completely dead and the marsh looked brown or black when viewed from the air. While the exact causes are not yet known, the general consensus was that this "brown marsh" phenomenon (BMP) was closely associated with the unique combination of environmental conditions from 1998 to 1999, culminating in severe drought in the year 2000.

The salt marshes in Terrebonne Parish and Lafourche Parish were the most seriously impacted during the salt marsh die back event. While the seasonal cycle of marsh plant die off and regeneration is natural, what is unusual is that the acreage involved in the current dieback area is unprecedented and little recovery has been noted in affected areas.

The concern over the brown marsh phenomenon elicited interest among scientists, State and Federal agencies, and the public. Many meetings were conducted in South Louisiana where scientists in State and Federal agencies, academia and private industry met to present and discuss their research findings on brown marsh issues. In January 2001 a two-day Brown Marsh Conference was held in Baton Rouge. More than 200 people attended, most of whom were government agency representatives and university scientists. While the significance of the Brown Marsh Phenomenon (BMP) in Louisiana is understood and acknowledged by the scientific community, the level of interest and understanding by the general public seems to vary, with many failing to understand why the BMP was important to them and their way of life. One of the challenges facing government agency administrators and the scientific community is presenting the brown marsh information to the general public in such a manner that the ramifications of the BMP will be clear. Louisiana Governor Mike Foster was clear on the issue, however, and on October 23, 2000 he declared Saltwater Marsh Dieback in Louisiana an emergency in Executive Proclamation #55-MJF-2000. Shortly thereafter, the federal government granted Louisiana $3 million to be used to fund "emergency" brown marsh research.

In February 2001, the Barataria-Terrebonne National Estuary Program (BTNEP) Scientific-Technical Committee posted a Request for Submission of Scope of Services for Salt Marsh Dieback and Nutria Control Emergency Response. Coastal Environments, Incorporated, a Baton Rouge-based applied science and planning company, submitted their bid for Task III.4 of the Salt Marsh Die Back and Nutria Control Emergency Response project. Task III.4 specifically tasked the following:

> Project potential socioeconomic impacts from marsh dieback. Incorporate information from ongoing studies of the Status and Trends and Causation tasks as available and the results of Task III.3. Socioeconomic considerations include but are not limited to infrastructure, drinking water supplies, storm and flood protection, living resources, industries, and mineral resource extraction.

For this project, the parishes of St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines and St. Bernard were chosen as the Project Area. CEI researcher Kim Barton, the primary author of this

report, described potential socioeconomic impacts to the project area using both an Environmental Assessment (EA) approach (Part One) and an Economics approach (Part Two); both approaches result in prediction and quantification of impacts. An Environmental Assessment provides a comprehensive identification and assessment of environmental impacts associated with a "project," in this case, salt marsh dieback, using National Environmental Policy Act (NEPA) guidelines. In an EA, socioeconomic characteristics and environmental resources (including land, water, ecological, aesthetic, cultural resources of a project area) are documented and described. Impacts to existing resources and socioeconomic characteristics as a result of a project are predicted and described.

In Part Two, Gerald Morrissey describes salt marsh die back impacts in Economic terms. He presents an explanation for the market value of salt marsh as real estate, explains why "market value" does not adequately represent the value of a salt marsh, illustrates some ways that a marsh may be assigned measurable, quantifiable value, and then generates a monetary value range for salt marshes within the six-parish project area.

In Parts One and Two, salt marsh die back impacts are discussed with respect to two loss scenarios: 1) loss of all project area salt marshes (total decimation), and 2) recovery of all salt marshes impacted by the BMP. In addition, Gerald Morrissey briefly addresses the scenario he terms "Status Quo," the scenario in which no additional salt marsh is lost but the marsh impacted by the 1999-2000 BMP does not recover.

PART ONE: A NEPA-BASED APPROACH

An Environmental Assessment (EA) is a process for evaluating the environmental and social consequences of proposed activities. This process allows for public participation and ensures economic development occurs in an environmentally responsible manner. The goals of an EA are to predict impacts and to minimize adverse impacts to the environment to aid decision-makers better decision-making.

The National Environmental Protection Act (NEPA) mandates EAs; it states that the purpose of environmental assessment is to "protect the environment and quality of life of the people of the project area and to facilitate the wise management of natural resources." It requires that anyone who plans to adopt or construct a project that could have a significant effect on the natural, social or economic environment must identify and describe the potentially-impacted resources and examine all potential ramifications of the project. The environmental assessment process ensures that projects proceed in an environmentally acceptable manner. When the potential environmental effects of projects are of concern, the process generates real benefits by: (i) providing for comprehensive project planning and design, (ii) maximizing environmental protection, (iii) enhancing government coordination, accountability and information exchange, and (iv) facilitating the permitting and regulatory approval of projects.

The primary author for Part One of this report decided to describe the impacts to the salt marsh as a result of the BMP using an EA-based approach because an EA describes resources, project-area characteristics, and impacts in a clear, concise and thorough manner.

SECTION 1. EXISTING ENVIRONMENT

Relevant land, water, ecological, aesthetic, cultural, and monetary resources of the six-parish project area are described in this section. The six parishes of the project area, as they are positioned from west to east across the Louisiana coast, are St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines, and St. Bernard (Figure 1).

1.1 Land Resources

Living in south Louisiana demands that residents acclimate to the unique landscape. Seventy percent of Louisiana's citizens live in the 18,000 square mile coastal zone, an area bounded by the Mississippi River delta to the east and the Chenier Plain to the west. Unfortunately less than one-third of the coastal zone, about 7,000 square miles in 1990, is land and less than 10 percent is greater than three feet above sea level; natural elevations exceed 35 feet above mean sea level (MSL) only at the five salt domes in the coastal zone (Dunbar *et al.*, 1992).

1.1.1 Topography

The six parishes in this project study area, St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines and St. Bernard (hereafter referred to collectively as "the project area"), are in the area of coastal Louisiana called the Deltaic Plain, though the Deltaic Plain also includes Vermilion and Iberia parishes. The Plain extends northward 300 river miles, from the Gulf of Mexico to the Old River Control Structure north of New Roads, Louisiana and from the Mississippi state line to Freshwater Bayou in Vermilion Parish. The landscape reflects the cyclic nature of delta building during the past 7,000 years. Every 1,000 years or so, the river has changed course to follow the shortest route to the Gulf. Deprived of sediment, the wetlands located near to and influenced by the old course would deteriorate. As the freshwater flow declined, tidal channels would develop, salt water would move inland, swamps would become marsh, and marsh would become open Gulf water.

Until humans intervened, the river's spring floods left behind layers of sediment that helped build swamps and marshes. When these floods disrupted settlements along the riverbanks, residents built levees, which in turn disrupted the natural processes that had created thousands of square miles of deltaic wetlands. As the settlers' levees lengthened and grew higher, natural outlets such as Bayous Manchac, Plaquemines, and Lafourche were bottled up, largely eliminating sediment and fresh water flow in those areas. Within the Deltaic Plain, early settlers in the area dredged canals through wetlands for drainage and cut channels for commerce - measures that made more of the area habitable, but eventually tilted the balance toward wetland destruction.

Today, some sediment still moves into the marshes south of Venice in Plaquemines Parish, and along the margins of Atchafalaya and Four League bays. Mud stirred up by hurricanes and winter cold fronts is also carried into shallow bays and adjacent wetlands from the Gulf, a process that is critical for maintaining saline and brackish marshes. However, in many places canals, artificial banks, and levees prevent water and sediment from reaching wetland plants. The most prominent examples of this process are the high levees bordering the Mississippi River

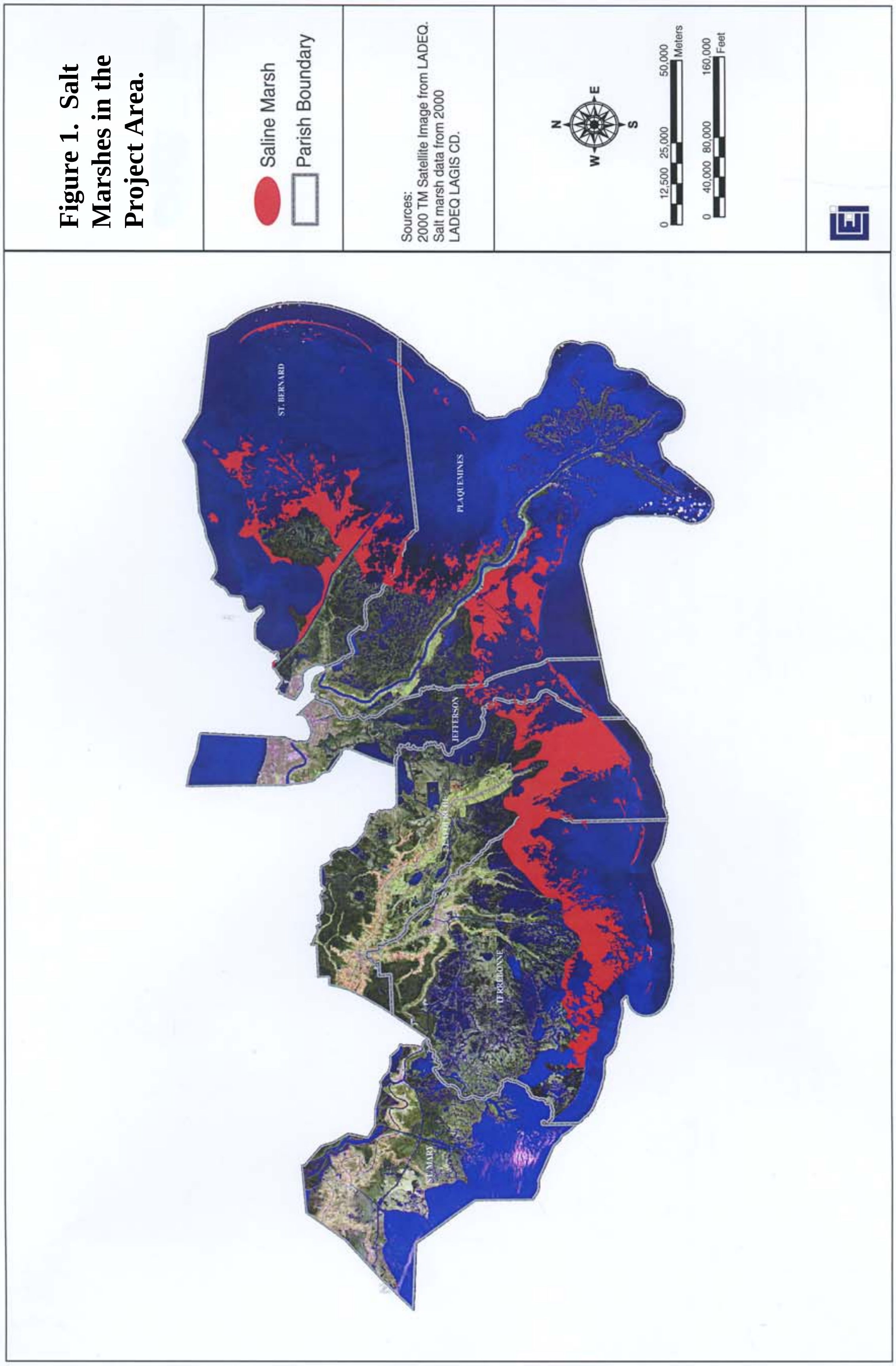

Figure 1. Salt Marshes in the Project Area.

that were built by the federal government to facilitate navigation and protect communities from river floods. Floodwaters channel most of the river's sediment off the continental shelf and deep into the Gulf. In addition to sediment loss, the interior basins of the Deltaic Plain receive much less fresh water than in the past. Consequently, the once abundant swamps and freshwater marshes are being replaced by open water at alarming rates. Scientists estimate that the Deltaic Plain is losing 23 square miles per year (The Coalition to Restore Coastal Louisiana, 2000 Revision).

1.1.2 Land Use

Land use within the project area consists of: 1) undeveloped land including marsh, 2) rural agricultural lands primarily with soy, cane, and corn cultivation, 3) residential, 4) some industrial/urban, and 5) open water. Oil and gas exploration and production activities are conducted both onshore and offshore (Figure 2).

The most complete readily available datasets for farming statistics were from 1997 and 2002, which are both outside of the "brown marsh" years; these datasets were used nonetheless. The number of farms in Jefferson Parish decreased from 1997 to 2002, though the acres of farm land, the average size of a farm, the total cropland and the total harvested cropland increased during the same time span. The number of farms and average farm size increased slightly in Lafourche Parish from 1997 to 2002 while the total acres of cropland (planted and planted/harvested) in the parish decreased. In Plaquemines Parish the number of farms, the total cropland and the total harvested cropland increased. All reported values decreased in both St. Bernard and St. Mary parishes. Finally, the number of farms, the acres of farmland and the acres of cropland increased in Terrebonne Parish, while the average acres per farm and the total acres of harvested cropland decreased (Table 1).

1.2 Water Resources

The six parishes of the project area encompass approximately 9,500 square miles, approximately fifty two percent of which is water. Plaquemines Parish is the largest of the six parishes with an area of approximately 2,400 square miles, sixty percent of which is water. Jefferson Parish is the smallest with approximately 650 square miles, of which approximately fifty percent is water. Table 2 presents land and water statistics for each parish.

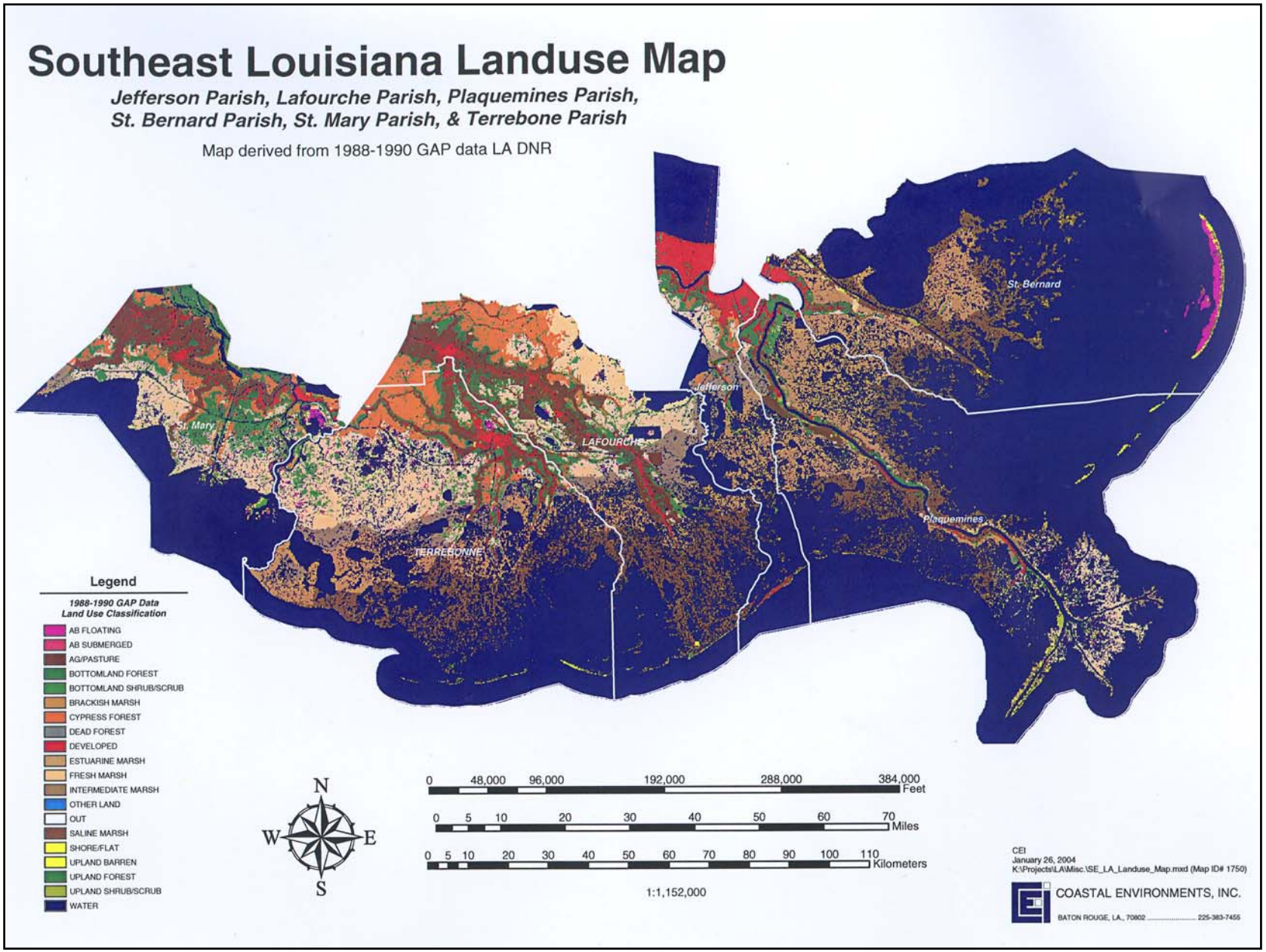

Figure 2. Land Use in Project Area.

Table 1. Farm Statistics, 1997 and 2002.

Parish	Jefferson		Lafourche		Plaquemines		St. Bernard		St. Mary		Terrebonne	
Year 2002	**1997**	**2002**	**1997**	**2002**	**1997**	**2002**	**1997**	**2002**	**1997**	**2002**	**1997**	**2002**
Farms (number)	62	52	398	405	127	192	27	24	103	99	137	156
Land in farms (acres)	4,836	7,630	132,042	150,927	36,756	34,797	3,404	(d)	83,166	73,410	52,873	53,056
Land in farms-average size of farm (acres)	78	147	339	373	289	181	126	(d)	807	742	386	340
Total cropland (acres)	1,815	2,864	69,402	57,602	4,523	6,900	1,568	815	65,199	62,592	30,956	32,121
Total cropland, Harvested cropland (acres)	488	1,712	42,636	35,728	1,305	2,088	872	100	50,404	48,335	18,660	16,609

Notes: (d) = data withheld to avoid disclosing data for individual farms.
National Agricultural Statistics Service, November 2003.

1.2.1 Surface Water

Hydrologically, the project area is located in the Mississippi River Alluvial Plain ecoregion (Omernik, 1987), which is characterized by low relief and slope, with cutoff lakes, streams and distributary bayous, cypress-tupelo gum swamps, and fresh-to-saline marshes. Streams in this ecoregion are naturally low-gradient, muddy and highly turbid, with moderate alkalinity and dissolved salts; many have natural connections between them, including distributaries and abandoned manmade canals that create complex drainage patterns. Because of the very slowly moving water, habitat conditions often resemble those of shallow lakes and ponds.

Drinking water in the project area is obtained from the surface; there are no freshwater aquifers along the Louisiana coast. As a result, surface waters may be contaminated with saltwater, agrochemicals and petroleum-related chemicals (U.S.G.S WRI reports 86-4150 and 94-4085).

1.2.2 Groundwater

No major freshwater aquifers occur in the region extending from the coastal marsh and delta area east of New Orleans to the western side of the Atchafalaya River Basin, as well as in some coastal areas in southwestern Louisiana. Thus the project area is located entirely within this aquifer-less region. However, locally discontinuous, shallow sand beds may supply some freshwater (U.S.G.S WRI reports 86-4150 and 94-4085).

1.3 Ecological Resources

Details of ecological resources, including state parks, wildlife preserves and management areas, and a discussion of threatened and endangered species in the project area are addressed in this section.

Table 2. Parish Land and Water Statistics.

	Jefferson		Lafourche		Plaquemines		St. Bernard		St. Mary		Terrebonne		Total	
Land Area														
Square Miles	305.9	44.4 %	1084.8	73.7 %	884.6	34.8 %	465.2	25.9 %	612.9	54.8 %	1,255.1	60.3 %	4570.9	47.9 %
Acres	196,479		694,400		540,799		297,599		392,319		803,200		2,924,796	
Water Area														
Square Miles	336.5	52.4 %	387.5	26.3 %	1584.0	65.2 %	1328.7	74.1 %	506.0	45.2 %	825.0	39.7 %	4970.3	52.1 %
Acres	215,358		247,990		1,013,791		850,351		323,831		528,010		3,179,331	
Total Square Miles	642.4		1472.3		2428.6		1793.9		1118.9		2080.1		9536.2	
Total Acres	441,151		942,271		1,554,364		1,148,055		716,110		1,331,249		6,03,200	

Center for Landscape Interpretation. (n.d.)

1.3.1 State Parks

There are approximately 39,000 acres of protected state lands in Louisiana, including state parks, commemorative areas, and preservation areas (Table 3). The Louisiana Department of Wildlife and Fisheries (LDWF) oversees more than a million acres of wildlife management areas and refuges to preserve habitats for fish and wildlife and to provide a wide range of opportunities for outdoor recreation. These lands also contribute economic advantages to hunters and trappers and, in coastal areas, function as nursery grounds for important Louisiana fishery resources. The LDWF Environmental Branch continues to work for the conservation of valuable fish and wildlife habitat throughout the state. Conservation efforts are accomplished in a variety of ways, including permitting, habitat evaluations, development and implementation of Scenic River Management Plans, documenting the occurrence and distribution of rare, threatened, and endangered species, and providing extension service assistance to various groups and government organizations relative to nongame and urban wildlife. There are seven state parks in the parishes of the project area with a total area of 1,291 acres (Louisiana State Parks, 2004).

1.3.2 Wildlife Management Areas

One of the most important and successful programs of the Louisiana Department of Wildlife and Fisheries has been the establishment and development of the wildlife management area (WMA) system throughout the state. Presently the Department operates and manages 48 wildlife management areas comprising a total of 1,231,913 acres (Table 3).

All areas are presently open to hunting and fishing and other outdoor recreation. They represent every habitat type found in the state including coastal marshes, bottomland hardwoods, cypress tupelo swamps, mixed pine hardwoods, longleaf pine savannahs, upland hardwood forests, upland longleaf pine forests, and shortleaf pine/oak/hickory forests. Since this program was initiated in the early 1950s, it has grown in popularity and now furnishes a wide variety of activities for the state's outdoor enthusiasts. It is estimated that wildlife management areas provide almost 1,000,000 outdoor trips annually to hunters, fishermen, boaters, campers, bird watchers and many others. Seven of these WMAs are within the parishes of the project area (Louisiana Department of Wildlife and Fisheries, n.d).

1.3.3 Threatened and Endangered Species

In Louisiana there are 37 plants and animals on the threatened and endangered species list. All six parishes of the project area have threatened and endangered animal species in residence. Table 4 lists the threatened and endangered plant and animal species for the state and by parish. (Louisiana Department of Wildlife & Fisheries, n.d.).

Table 3. State Parks, Refuges and Management Areas.

	State Parks		Wildlife Refuges		Wildlife Management Area	
Parish	**Name**	**Acres**	**Name**	**Acres**	**Name**	**Acres**
Jefferson	Bayou Segnette Fort Livingston Grande Isle East Grande Isle West	580 2 120 40	Barataria National Wildlife Preserve	20,000*		
Lafourche	Edward Douglass White	6			Wisner	21,621
					Point-au-Chien	33,488
Plaquemines			Delta NWR	48,800*	Pass-A-Loutre	66,000
St. Bernard	St. Bernard	358	Benton NWR	6,923	Biloxi WMA	39,583
St. Mary	Cypremort	185			Atchafalaya Delta	137,000
					Attakapas	26,3000
Terrebonne			Terrebonne Barrier Islands	630*	Point-au-Chien	33,488

Louisiana State Parks, 2004

Table 4. Threatened and Endangered Species.

In the Project Parishes				
	Jefferson, Plaquemines (11)	**Lafourche, Terrebonne (10)**	**St. Bernard (10)**	**St. Mary (11)**
Species	Bald Eagle West Indian Manatee Brown Pelican Piping Plover Gulf Sturgeon Pallid Sturgeon Green Sea Turtle Hawksbill Sea Turtle Kemp's Ridley Sea Turtle Leatherback Sea Turtle Loggerhead Sea Turtle	Bald Eagle West Indian Manatee Brown Pelican Piping Plover Gulf Sturgeon Green Sea Turtle Hawksbill Sea Turtle Kemp's Ridley Sea Turtle Leatherback Sea Turtle Loggerhead Sea Turtle	West Indian Manatee Brown Pelican Piping Plover Gulf Sturgeon Pallid Sturgeon Green Sea Turtle Hawksbill Sea Turtle Kemp's Ridley Sea Turtle Leatherback Sea Turtle Loggerhead Sea Turtle	Louisiana Black Bear Bald Eagle Brown Pelican Piping Plover Gulf Sturgeon Pallid Sturgeon Green Sea Turtle Hawksbill Sea Turtle Kemp's Ridley Sea Turtle Leatherback Sea Turtle Loggerhead Sea Turtle

In the State				
	Louisiana (37)			
Species	**Plants:** American Chaffseed Earthfruit Louisiana Quillwort **Invertebrates:** American Burying Beetle Fat Pocketbook Inflated Heelsplitter Louisiana Pearlshell Pink Mucket **Amphibians:** Mississippi Gopher Frog	**Fish:** Pallid Sturgeon Gulf Sturgeon **Reptiles:** Green Sea Turtle Hawksbill Sea Turtle Kemp's Ridley Sea Turtle Leatherback Sea Turtle Loggerhead Sea Turtle Gopher Tortoise Ringed Sawback Turtle	**Birds:** Brown Pelican Bald Eagle Peregrine Falcon Attwater's Greater Prairie Chicken Whooping Crane Eskimo Curlew Piping Plover Interior Least Tern Ivory Billed Woodpecker Red-Cockaded Woodpecker Bachman's Warbler*	**Mammals** Manatee Blue Whale Finback Whale Sei Whale Sperm Whale Red Wolf Black Bear Florida Panther

U.S. Fish & Wildlife Services, April 2003; Louisiana Department of Wildlife & Fisheries, n.d.

1.4 Aesthetic Resources

1.4.1 Scenic Waterways, Scenic Highways

The Louisiana Department of Wildlife and Fisheries (LDWF) administers the Louisiana Natural and Scenic Rivers System, established in 1970 for the purpose of preserving, developing, reclaiming and enhancing the wilderness qualities, scenic beauty and ecological regime of designated free-flowing water bodies. Fifty-one streams encompassing approximately 1,300 miles of warm water streams in Louisiana have been declared part of the Natural and Scenic Rivers System. A natural and scenic river is defined by law as a river, stream or bayou that is in a free-flowing condition and has not been channelized, cleared or snagged within the past 25 years, realigned, inundated or otherwise altered, has a shoreline covered by native vegetation and has no or few manmade structures along its banks. LDWF considers the following factors for each stream: fish and wildlife habitat, typical fish and wildlife species, protected/rare/endangered/ threatened species (PRETS), geological/hydrological features, water quality, historical/archaeological, wilderness quality/scenic value and recreation. There are seven designated Scenic Rivers in the project area (Louisiana Department of Environmental Quality, 1996).

The National Scenic Byways Program is intended to recognize highways that are outstanding examples of scenic, historic, recreational, cultural, archeological, and/or natural qualities by designating them as either National Scenic Byways or All-American Roads. The Creole Nature Trail, Louisiana's only nationally designated Scenic Byway, ends at the Rockefeller Wildlife Refuge in Vermilion parish, just outside of the project area (National Scenic By Ways On-line, 2003; What You Need to Know About U.S./Canadian Parks, 2003).

Eight of the state's fifty-one federally designated Scenic Waterways, totaling 38 miles, are located in the project area. The longest waterway is Bayou des Allemands in Lafourche parish, which runs from Lac des Allemandes to Lake Salvador. Five of the six parishes in the project area have scenic roads. Table 5 presents scenic waterways and roads within the project area.

1.5 Cultural Resources

St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines and St. Bernard parishes are all part of an area designated as Cajun Country by the Louisiana Office of Culture, Recreation and Tourism because of the presence of the Acadian French settlers from Nova Scotia. Cajun (the word is a corruption of the original French pronunciation of Acadian--A-ca-jan) Country today lies within a triangle whose base is the Louisiana coast and whose apex is near Alexandria in the central part of the state. The triangle contains 22 parishes and the region's principal city, Lafayette, is the unofficial capital of "Acadiana." Cajun Country is well known for unique music and food, and an abundance of hunting, fishing, and festivals (Louisiana Department of Culture, Recreation and Tourism, 1996).

In addition to "Cajun Country," predominately Catholic French southern Louisiana has been described as "South of the South" because of the Mediterranean-African roots and plantation past of the region, that make it and New Orleans more akin to societies in the Spanish and French West Indies than the American South. The Cajuns, who came from what is now Nova Scotia in

Table 5. Scenic Waterways.

Parish & Name of Scenic Waterway	Parish & Name of Scenic Roads
Jefferson (none)	**Jefferson**
	River Road Scenic Byway
Lafourche	
Bayou des Allemands	**Lafourche**
	Cultural Wetlands Scenic Byway
Plaquemines (none)	
	Plaquemines (none)
St. Bernard	
Bashman Bayou	**St. Bernard**
Bayou Bienvenu	San Bernardino Scenic Byway
Bayou Chaperon	
Bayou Dupre	
Lake Borgne Canal (Violet Canal)	
Pirogue Bayou	
Terre Beau Bayou	**St. Mary**
	Bayou Teche Scenic Byway
St. Mary (none)	
	Terrebonne
Terrebonne (none)	Cultural Wetlands Scenic Byway
Six-Parish Total 38 miles	**Six Parish Total 309 Miles**

Louisiana Department of Environmental Quality, 1996.
National Scenic By Ways On-line, 2003.
What You Need to Know About U.S./Canadian Parks, 2003.

the late eighteenth century, dominate the rural part of south Louisiana. However, over time the Cajuns have absorbed and been affected by a wide array of cultures in the area including Spanish, German, Italian, Anglo, Native American, and Slavonian.

The distinctive food (gumbo, jambalaya, crawfish etouffee), music (Cajun music and zydeco), material culture (Creole cottages, shotgun houses, pirogues and bateaux), ritual/festive practices (folk Catholicism, home altars, traiteurs, Mardi Gras), and languages (Cajun and Creole French, Spanish, Dalmatian, and Indian languages), reflect a diversity of cultures unified in one region (Spitzer, 1999). Table 6 presents a number of cultural resources in the project area.

1.6 Monetary Resources

1.6.1 Tourism

The state of Louisiana experienced a twenty-three percent increase in tourism-related revenues from 1997 to 2001 (Table 7). All six parishes in the project area increased their tourism revenues as well. St. Mary Parish had the greatest increase with 353 percent. Project-area employment also increased as a result of tourism, from approximately two percent in Jefferson Parish to 490 percent in St. Mary Parish (Louisiana Tourism Data Resources, 2004).

Table 6. Cultural Resources.

Resource	Parish					
	Jefferson	**Lafourche**	**Plaquemines**	**St. Bernard**	**St. Mary**	**Terrebonne**
Annual Festivals	41	29	7	23	14	32
Historic Places	18	17	8	7	24	16
Archaeological Sites	296	266	157	141	184	306
Tourist Attractions						
Bed & Breakfast	2	7	1	0	4	9
Campgrounds	3	2	0	1	2	3
Casinos	1	0	0	0	1	0
Museums	2	0	0	1	1	2
Plantations	2	0	0	0	0	0
Science & Nature	0	1	0	0	0	0
Sightseeing	1	1	0	1	1	2
Swamp Tours	4	2	0	0	2	4
Theater/Arts	1	0	0	0	0	0

Louisiana Department of Culture, Recreation and Tourism, 1996.

Table 7. Revenues from Tourism.

	1997	**1998**	**1999**	**2000**	**2001**	**% change from 1997-2001**
Jefferson						
Revenues (millions)	$729.40	$747.30	$782.97	$874.01	$852.72	+16.9
Employment (thousand)	9.58	9.87	10.00	10.61	9.73	+1.6
Lafourche						
Revenues (millions)	$47.11	$48.50	$50.82	$57.90	$55.79	+18.4
Employment (thousand)	0.40	0.42	0.43	0.46	0.45	+12.5
Plaquemines						
Revenues (millions)	$16.28	$17.56	$18.93	$20.04	$18.97	+16.5
Employment (thousand)	0.16	0.19	0.19	0.20	0.19	+18.8
St. Bernard						
Revenues (millions)	$29.58	$29.70	$32.27	$35.67	$35.53	+20.1
Employment (thousand)	0.26	0.27	0.28	0.28	0.29	+11.5
St. Mary						
Revenues (millions)	$31.68	$42.41	$44.30	$49.89	$143.71	+353.6
Employment (thousand)	0.33	0.55	0.56	0.60	1.95	+490.9
Terrebonne						
Revenues (millions)	$65.45	$69.84	$71.45	$80.25	$82.98	+26.8
Employment (thousand)	0.65	0.70	0.71	0.75	0.78	+20.0
Louisiana						
Revenues (millions)	$6,878.04	$7,169.10	$7,631.00	$8,177.71	$8,490.55	+23.4
Employment (thousand)	102.36	106.80	110.30	113.81	116.79	+14.1

Louisiana Tourism Data Resources, 2004.

1.6.2 Aquaculture

The primary freshwater aquaculture products in the project area are crawfish, oysters, soft-shell crabs and catfish. In five of the six parishes, crawfish sales decreased from 1997 to 2001; Lafourche increased crawfish sales by greater than 120 percent. Oyster sales decreased in all parishes but Jefferson, in which sales increased from 124,089 sacks in 1997 to 228,845 sacks in 2001. Soft shell crab sales decreased in Lafourche and Plaquemines parishes, but increased 227 percent in St. Mary Parish. Farm-raised catfish sales decreased in all parishes. Table 8 presents sales statistics for all six parishes from 1997 to 2001 (Louisiana State University Ag Center, 2004).

The primary marine aquaculture products in the project area are shrimp, crabs, and commercial finfish. In the six-parish project area, total sales of shrimp increased 25.7 percent, from 73,611,048 pounds in 1997 to 99,023,278 pounds in 2001. Sales of crabs increased 3.5 percent, from 26,758,240 in 1997 to 27,720,058 pounds in 2001.

In 2001 commercial finfish sales were down in Jefferson, Plaquemines, St. Bernard, and St. Mary parishes. Lafourche and Terrebonne Parishes marine aquaculture sales increased for all three products from 1997 to 2001. Table 9 presents marine sales statistics for all six parishes from 1997 to 2001.

1.6.3 Taxes

Tax collection generates a major source of income for parishes. In south Louisiana sales taxes on goods and services and taxes on natural resources generate approximately $400 million dollars annually. "Natural resources" include oil/condensate, gas, timber/pulpwood, and minerals. In the project area, Plaquemines Parish collected the most revenues from oil/condensate, approximately 44 million dollars or 16.8 percent of the oil/condensate tax revenues for the entire state of Louisiana. Plaquemines and Terrebonne parishes collected the most gas tax revenues, approximately eight million dollars. Sales taxes collected on goods and services also generate substantial revenues for the parishes. Table 10 presents tax revenues by parish.

Table 8. Sales of Fresh- and Saltwater Aquaculture Products.

JEFFERSON							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**2000**	**2001**	**% Change 1997-2001**
Crawfish	Pounds sold	29,000	31,610	-	6,000	-	-100.00
Oysters	Sacks	124,089	29,254	57,908	43,943	228,845	+84.42
Soft-shell Crabs	Pounds sold	44,362	49,581	49,581	44,363	45,400	+2.34
Catfish	Pounds sold	-	-	-	-	-	
LAFOURCHE							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**2000**	**2001**	**% Change 1997-2001**
Crawfish	Pounds sold	1,926,777	1,011,539	997,300	498,650	4,417,000	+129.24
Oysters	Sacks	140,957	113,166	20,792	107,900	111,300	-21.04
Soft-shell Crabs	Pounds sold	9,885	9,551	450	515	775	-92.16
Catfish	Pounds sold	51,000	28,550	25,150	-	-	-100.00
PLAQUEMINES							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**2000**	**2001**	**% Change 1997-2001**
Crawfish	Pounds sold	120,000	80,400	67,500	-	-	-100.00
Oysters	Sacks	1,158,726	1,179,000	589,888	589,888	16,281	-98.59
Soft-shell Crabs	Pounds sold	1,950	2,115	1,850	1,850	1,850	-5.13
Catfish	Pounds sold	-	-	-	-	-	
ST BERNARD							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**2000**	**2001**	**% Change 1997-2001**
Crawfish	Pounds sold	-	-	-	-	-	
Oysters	Sacks	623,500	648,871	481,315	-	329,182	-47.20
Soft-shell Crabs	Pounds sold	4,300	5,100	5,100	5,100	5,000	+16.28
Catfish	Pounds sold	-	-	-	-	-	
ST. MARY							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**2000**	**2001**	**% Change 1997-2001**
Crawfish	Pounds sold	420,000	390,000	340,000	119,000	122,400	-70.86
Oysters	Sacks	107,855	10,000	76,932	75,500	75,000	-30.46
Soft-shell Crabs	Pounds sold	5,500	5,000	5,000	18,000	18,000	+227.27
Catfish	Pounds sold	-	-	-	-	-	
TERREBONNE							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**2000**	**2001**	**% Change 1997-2001**
Crawfish	Pounds sold	597,900	320,000	160,000	80,000	291,000	-51.33
Oysters	Pounds sold	683,855	607,449	523,364	540,172	223,244	-67.36
Soft-shell Crabs	Sacks	2,050	2,000	2,000	2,250	2,105	+2.68
Catfish	Pounds sold	-	-	-	-	-	

Louisiana State University Ag Center, 2004.

Table 9. Sales of Marine Aquaculture Product.

JEFFERSON							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**200**	**2001**	**% Change from 1997 - 2001**
Shrimp	Pounds sold	15,051,159	17,760,367	17,760,367	21,377,172	16,247,838	7.4
Crabs	Pounds sold	2,494,408	2,004,430	2,464,653	2,217,795	2,220,066	-12.4
Commercial Finfish	Pounds sold	4,901,299	3,588,219	3,605,225	2,650,947	2,458,447	-99.4
LAFOURCHE							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**200**	**2001**	**% Change from 1997 - 2001**
Shrimp	Pounds sold	11,668,901	13,500,000	13,500,000	11,350,000	16,855,000	30.8
Crabs	Pounds sold	4,322,910	2,783,962	3,257,539	7,260,235	5,000,000	13.5
Commercial Finfish	Pounds sold	2,070,510	1,831,736	1,924,521	4,138,476	2,293,295	9.7
PLAQUEMINES							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**200**	**2001**	**% Change from 1997 - 2001**
Shrimp	Pounds sold	17,059,168	20,105,000	20,105,000	20,105,000	30,064,329	43.3
Crabs	Pounds sold	2,726,500	2,019,400	3,347,331		1,709,970	-59.4
Commercial Finfish	Pounds sold	22,579,600	15,203,000	9,718,145	9,718,145	2,695,047	-737.8
ST. BERNARD							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**200**	**2001**	**% Change from 1997 - 2001**
Shrimp	Pounds sold	3,678,412	4,533,000	4,533,000		3,611,111	-1.9
Crabs	Pounds sold	3,507,500	4,331,000	6,059,010		2,940,022	-19.3
Commercial Finfish	Pounds sold	500,300	329,000	1,993,062		40,156	-1,145.9
ST. MARY							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**200**	**2001**	**% Change from 1997 - 2001**
Shrimp	Pounds sold	300,000	378,900	378,900	860,000	2,100,000	85.7
Crabs	Pounds sold	4,841,354	4,700,000	5,325,766	6,400,000	6,000,000	19.3
Commercial Finfish	Pounds sold	41,606	52,000	482,005	15,000	15,000	-177.4
TERREBONNE							
Aquaculture Product	**Units**	**1997**	**1998**	**1999**	**200**	**2001**	**% Change from 1997 - 2001**
Shrimp	Pounds sold	25,853,408	28,402,388	28,402,388	34,561,118	30,145,000	14.2
Crabs	Pounds sold	8,865,568	7,227,569	7,452,674	7,512,902	9,850,000	10.0
Commercial Finfish	Pounds sold	130,206	60,098	1,500,748	1,728,540	3,150,000	95.9

Louisiana State University Ag Center, 2004.

Table 10. Revenues from Taxation.

CASH COLLECTIONS BY PARISH 1990-2000					
Natural Resources					
PARISH	**OIL/CONDENSATE**	**GAS**	**TIMBER/PULPWOOD**	**MINERALS**	**TOTAL TAX COLLECTED**
Jefferson	8,470,477.43	1,032,817.51	2153.20	140,899.15	9,646,347.29
Lafourche	24,013,171.12	3,770,425.12	554.45	3302.92	27,787,453.61
Plaquemines	43,658,281.99	8,186,232.15	1071.85	23,046.58	51,868,632.57
St. Bernard	3,040,886.43	376,269.37	2369.52	26,217.82	3,445,743.14
St. Mary	11,836,651.88	5,358,249.77	137.31	130,773.93	17,325,812.89
Terrebonne	20,209,496.01	8,528,321.07	1504.81	0	28,739,321.89
TOTAL	$111,228,964.86	$27,252,314.99	$7,791.14	$324,240.40	$138,813,311.39
State Totals	$259,602,945.75	$94,711,200.06	$20,817,645.34	$1,569,201.43	$376,700,992.58

Net Sales Tax Collections by Parish		
PARISH	**1998-99**	**1990-00**
Jefferson	199,542,895	209,703,039
Lafourche	11,854,420	13,552,665
Plaquemines	6,542,260	6,245,912
St. Bernard	9,495,173	9,688,956
St. Mary	11,921,409	11,104,032
Terrebonne	23,648,361	23,428,018
* These are unaudited figures and reflect only where the tax was reported, which is not necessarily the same parish where the tax was collected.		

State of Louisiana Department of Revenue Online Services, December 12, 2001

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SECTION 2. SOCIAL AND ECONOMIC CHARACTERISTICS

This section describes the existing socioeconomic characteristics of the six-parish project area.

2.1 Demographics

Demographics describe the physical characteristics of a population including population change over time, age, family size, race, and population districting.

2.1.1 Population Trends

During the last decade, 1990-2000, five of the six parishes in the project area experienced population increases (Table 11).

The population in Jefferson Parish increased from 1990 to 2000 by 1.6 percent to 455,466 people. The most populated incorporated city in the parish is Kenner, with 70,517 people, or 15 percent of the total parish population.

Lafourche Parish' population increased 4.8 percent from 1990-2000. The most populated incorporated place in Lafourche is Thibodaux, with a population of 14,431, or 16 percent of the total parish population.

As of the 2000 Census, there were no incorporated places in the parishes of Plaquemines or St. Bernard. The population in Plaquemines increased 4.6 percent, to 26,757 persons, and the population in St. Bernard increased 0.90 percent to 67,229 persons from 1990-2000.

Morgan City is the largest incorporated place in St. Mary Parish, with a population of 12,703, which is 24 percent of the total parish population of 53,500.

The most populated incorporated city in Terrebonne Parish is Houma, with a population of 32,393, 31 percent of the parish population of 104,503 [U. S. Census Bureau, American FactFinder, (a) and (b)].

2.1.2 Race and Age

Racial statistics for the State of Louisiana indicate a white majority of approximately 64 percent with a large African-American minority of 32.5 percent, a minority of American Indian, Asian, and Hispanic populations totaling approximately four percent, and a minority Hispanic population of approximately two percent. The racial composition in the project area is similar to the State of Louisiana's demographics, with a white majority and a large African-American minority. Asian and Hispanic populations are much larger in Jefferson Parish than in the rest of the state; Jefferson Parish is the most ethnically diverse parish in the project area. All of the parishes have comparable ratios of males to females, approximately 50:50 [U. S. Census Bureau, American FactFinder, (b)]. The median age in all parishes was approximately 35 (Table 12).

Table 11. Project Area Population by Parish.

	Jefferson Parish	Lafourche Parish	Plaquemines Parish	St. Bernard Parish	St. Mary Parish	Terrebonne Parish
Population, 2000	455,466	89,974	26,757	67,229	53,500	104,503
Population change, 1990-2000	7160	4114	1182	598	-4586	7521
Population, % change, 1990-2000	1.60 %	4.80 %	4.60 %	0.90 %	-7.90 %	7.80 %
Major Incorporated City	Kenner	Thibodaux	-	-	Morgan City	Houma
City Population	70,517	14,431	-	-	12,703	32,393

U. S. Census Bureau, American FactFinder (n.d.) (a) & (b)

Table 12. Racial Composition and Age by Parish.

	Jefferson		Lafourche		Plaquemines		St. Bernard		St. Mary		Terrebonne	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Total Population	**455,466**	**100**	**89,974**	**100**	**26,757**	**100**	**67,229**	**100**	**53,500**	**100**	**104,503**	**100**
White	318,002	69.8	74,544	82.9	18,668	69.8	59,356	88.3	33,591	62.8	77,401	74.1
African American	104,121	22.9	11,349	12.6	6258	23.4	5122	7.6	17,009	31.8	18,594	17.8
American Indian	2032	0.4	2066	2.3	553	2.1	329	0.5	741	1.4	5533	5.3
Asian	14,065	3.1	599	0.7	700	2.6	889	1.3	877	1.6	845	0.8
Hispanic or Latino	32,418	7.1	1264	1.4	433	1.6	3425	5.1	1152	2.2	1631	1.6
Male	218,702	48.0	43,877	48.8	13,335	49.8	32,495	48.3	26,063	48.7	51,345	49.1
Female	236,764	52.0	46,097	51.2	13,422	50.2	34,734	51.7	27,437	51.3	53,158	50.9
Median age (years)	35.9		34.1		33.7		36.6		34.3		33	

U. S. Census Bureau, American FactFinder (n.d.) (b)

2.2 Economic characteristics

Economic characteristics of the project area, including income and poverty, employment statistics and major parish employers are presented in this section.

2.2.1 Income and Poverty

According to the 2000 U.S. Census, the median household income in the state of Louisiana was $32,566, the per capita income was $16,912, and approximately 20 percent of the population subsisted below the poverty level. For a family of four the poverty threshold was $17,029. St. Mary Parish was the only parish in the project area with a median income less than the state median; only in Jefferson Parish was the per capita income greater than the state average, and approximately 24 percent of St. Mary Parish subsisted below the state average poverty level (Table 13) [U.S. Census Bureau, American FactFinder (n.d.) (b)].

Table 13. Income and Poverty.

Statistic	Jefferson Parish	Lafourche Parish	Plaquemines Parish	St. Bernard Parish	St. Mary Parish	Terrebonne Parish	Louisiana
Median Household Income	$38,435	$34,910	$38,173	$35,939	$28,072	$35,235	$32,566
Persons per household	2.56	2.75	2.89	2.64	2.74	2.86	2.62
Per Capita Income	$19,953	$15,809	$15,937	$16,718	$13,399	$16,051	$16,912
Percent of Population Below the Poverty Level	13.70 %	16.50 %	18.00 %	13.10 %	23.60 %	19.10 %	19.60 %

U. S. Census Bureau, American FactFinder (n.d.) (b)

2.2.2 Employment

Table 14 presents the top five employment sectors in the project area parishes and in the state. Retail trade employs the largest percentage of people in Jefferson, Lafourche, St. Bernard, and Terrebonne parishes. Manufacturing is the main employment industry in Plaquemines and St. Mary parishes. The healthcare industry employs the greatest percentage of workers at the state level. Local, State and Federal government employs more individuals than does the private sector. The largest employers (in terms of workforce employed) in the project area include Al Copeland Enterprises, Avondale Shipyard, McDermott, Inc., and the school boards of Jefferson and the Terrebonne parish. The top three employers in each parish and the number of people they employ are presented in Table 15.

Jefferson Parish has the greatest labor force of the six parishes with 231,100 and one of the lower unemployment rates at 3.8 percent. St. Mary Parish has the smallest labor force, approximately 24,000, and the highest unemployment rate, 5.5 percent. Half of the parishes had higher unemployment rates than the state average of 4.9 percent (Table 16) [U. S. Census Bureau, American FactFinder (n.d.) (c)].

Table 14. Employment by Industry.

JEFFERSON			
Industry	**Employees**	**Percent**	**Establishments**
Retail Trade	33,234	15.2	1979
Health Care & Social Assistance	28,717	13.2	1275
Accommodation & Food Service	22,259	10.2	1001
Admin, Support, Waste Mgt, Remediation Services	18.995	8.7	683
Manufacturing	17,811	8.2	420
Parish Total	**218,050**	**55.5**	**12,904**
LAFOURCHE			
Industry	**Employees**	**Percent**	**Establishments**
Retail Trade	3968	16.2	319
Health Care & Social Assistance	3106	12.6	170
Manufacturing	3050	12.4	63
Transportation & Warehousing	2843	11.6	187
Admin, Support, Waste Mgt, Remediation Services	2101	8.6	55
Parish Total	**24,558**	**61.4**	**1820**
PLAQUEMINES			
Industry	**Employees**	**Percent**	**Establishments**
Manufacturing	2281	18.5	45
Construction	2094	17.0	59
Transportation & Warehousing	1830	14.9	111
Wholesale Trade	1086	8.8	87
Accommodation & Food Service	721	5.9	44
Parish Total	**12,298**	**65.1**	**748**
ST. BERNARD			
Industry	**Employees**	**Percent**	**Establishments**
Retail Trade	3411	24.1	212
Health Care & Social Assistance	2377	16.8	122
Manufacturing	1795	12.7	50
Accommodation & Food Services	1392	9.8	120
Other Services (Except Public Administration)	921	6.5	140
ST. MARY			
Industry	**Employees**	**Percent**	**Establishments**
Manufacturing	4880	21.0	73
Transportation & Warehousing	2737	11.8	90
Retail Trade	2711	11.7	238
Accommodation & Food Service	1606	6.9	100
Construction	1386	6.0	121
Parish Total	**23,212**	**57.4**	**1448**
TERREBONNE			
Industry	**Employees**	**Percent**	**Establishments**
Retail Trade	6533	16.7	501
Health Care & Social Assistance	4659	11.9	201
Manufacturing	4415	11.3	123
Accommodation & Food Services	3462	8.8	184
Mining	3368	8.6	82
Parish Total	**39,186**	**57.3**	**2679**

U. S. Census Bureau, American FactFinder (n.d.) (c)

Table 15. Top Three Employers in Each Project Parish.

Parish	Name of Employer	Product or Service	Employees
Jefferson			
	Al Copeland Enterprises	Construction	14,600
	Jefferson Parish School Board	Education	7,000
	Avondale Shipyards, Inc.	Marine Construction	6000
Lafourche	Lafourche Parish School Board	Education	1,811
	Thibodaux Regional Medical	Medical	728
	Bollinger Machine Shop Shipyard, Inc.	Shipbuilding/Repair	750
Plaquemines	Plaquemines Parish School Board	Education	632
	Metropolitan Development Center	Handicap Facility	588
	Plaquemines Parish Government	Parish Government	550
St. Bernard	Mobil Oil Corporation	Petroleum Products	665
	Chalmette Medical Centers	Medical	630
	Amstar Sugar Corporation	Sugar Cane Refining	500
St. Mary	McDermott, Inc.	Shipbuilding/Pipe Fabrication/Steer	2400
	St. Mary Parish School System	Education	1,416
	Cypress Bayou Casino	Gaming	950
Terrebonne	Terrebonne Parish School System	Education	2,237
	Terrebonne Parish Medical System	Medical	1,012
	Leonard Chabert Medical System	Medical	950

Louisiana Electronic Assistance Program (n.d.)

Table 16. Labor Force and Unemployment.

Parish	Total Labor Force	Unemployment Rate
Jefferson	231,100	3.8 %
Lafourche	41,800	2.5 %
Plaquemines	10,300	4.9 %
St. Bernard	31,500	5.1 %
St. Mary	24,110	5.5 %
Terrebonne	47,100	2.9 %
Louisiana	1,935,600	4.9 %
Parish Total	385,910	

FedStats, 2001

2.3 Community Infrastructure

Characteristics of community support services within the project area including education, housing and social services statistics are presented in this section.

2.3.1 Education

In 2001 the statewide population of children enrolled in grades kindergarten through 12 was approximately 740 thousand, with approximately 55,000 faculty members. The student-to-faculty ratio in the state was approximately 13:1. In the state, 37.5 percent of educators have at least a Master's degree, 9.5 per cent of students drop out before completing ninth grade and 7.4 percent drop out before completing twelfth grade.

Approximately 101,000 students were enrolled in public schools in the six-parish project area in 2001. There were approximately 8,100 faculty members, for a student-to-faculty ratio of approximately 13:1. Of the six parishes, Jefferson Parish has the highest student enrollment, 50,894, the greatest number of faculty members (3,369) and the highest percentage of educators with a Master's degree or better (36%). Jefferson Parish has the highest percentage of students who drop out of school before completing ninth grade (13.0%). St. Mary and St. Bernard parishes have the highest number of students who drop out before completing twelfth grade (7.9%).

Plaquemines Parish has the lowest enrollment (4,978) and the fewest faculty members (370). Plaquemines Parish also had the lowest ninth grade dropout rate (2.4%), the lowest high school drop out for rate (1.7%). Table 17 presents public school statistics for the six parishes in the project area and the state (Louisiana Department of Education, 2001).

2.3.2 Housing

There are 1,847,181 housing units in the state of Louisiana (Census 2000). Approximately 98 percent (98%) of these housing units are occupied; approximately 68 percent are owner-occupied. Two percent of the available housing units are classified as "occasional use;" occasional use dwellings are used seasonally or for recreation only.

Jefferson Parish has the greatest number of housing units in the project area (approximately 187,000), an occupancy rate of approximately 94 percent, and an owner-occupancy rate of approximately 64 percent. Only one percent of the housing units are occasional use dwellings.

Plaquemines Parish has the fewest housing units (10,481), the highest percentage of occasional-use dwellings (5.2%), and the highest rate of owner-occupancy (78.9%). The other four parishes have similar statistics with respect to the number of housing units, the percent of occasional-use dwellings, and the owner-occupancy rates (Table 18) [U.S. Census Bureau, n.d. (d)].

Construction permit data for the six parishes indicates that permits for new construction in the project area parishes fluctuated from 1997 to 2001. From 1999 to 2000, residential building permits decreased in all project area parishes except Terrebonne, in which permitting increased only 0.5 percent. From 2000 to 2001, new building permit applications increased in Jefferson, Plaquemine, St. Bernard and Terrebonne parishes (Table 19) (Louisiana Department of Economic Development, 2001).

Table 17. Public School Statistics, 2001.

	Jefferson	Lafourche	Plaquemines	St. Bernard	St. Mary	Terrebonne	Louisiana
Schools	85	28	9	14	27	42	1,532
Faculty							
# of Faculty	3,369	1,344	370	664	815	1,577	55,526
% at least a Master's Degree	36.2	25.7	25.7	34.2	30.3	29.4	37.5
Students							
# of Students,	50,891	15,165	4,978	8,536	10,724	19,774	741,553
% High School Graduates							
	79.3	66.3	68.7	73.1	65.9	67.1	32.4
% of Dropouts							
Before Grade 9	8.4	2.4	3.7	3.6	1.7	3.9	5.5
Grades 9-12	11.0	6.6	2.8	8.0	7.7	10.4	8.6

Louisiana Department of Education, 2001.

Table 18. Housing Statistics.

HOUSING OCCUPANCY	Jefferson		Lafourche		Plaquemines		St. Bernard	
	Number	%	Number	%	Number	%	Number	%
Total housing units	**187,907**		**35,045**		**10,481**		**26,790**	
Occupied housing units	176,234	93.8	32,057	91.5	9,021	86.1	25,123	93.8
Vacant housing units	11,673	6.2	2,988	8.5	1,460	13.9	1,667	6.2
For seasonal, recreational, or occasional use	1936	1.0	923	2.6	542	5.2	366	1.4
Homeowner vacancy rate		1.2		0.9		1.3		1.1
Rental vacancy rate		7.2		8		8.9		5.7
Owner-occupied housing units	112,549	63.9	24,998	76.0	7117	78.9	18,753	74.6
Renter-occupied housing units	63,685	36.1	7,059	22.0	1,904	21.1	6,370	25.4

HOUSING OCCUPANCY	St. Mary		Terrebonne		Louisiana	
	Number	%	Number	%	Number	%
Total housing units	**21,650**		**39,928**		**1,847,181**	
Occupied housing units	19,317	89.2	35,997	90.2	1,656,053	98.7
Vacant housing units	2,333	10.8	3,931	9.6	191,128	10.3
For seasonal, recreational, or occasional use	410	1.9	1424	3.6	39,578	2.1
Homeowner vacancy rate		1.1		1		1.6
Rental vacancy rate		11.8		8.5		9.3
Owner-occupied housing units	14,279	73.9	27,212	75.6	1,125,135	67.9
Renter-occupied housing units	5,038	26.1	8,785	24.4	530,918	32.1

U. S. Census Bureau, American FactFinder (n.d.) (d)

Table 19. Louisiana Residential Permits by Parish.

Parish	1997	Building	% Change	1998	Building	% Change	1999	Building	% Change
Jefferson		649	1.7		772	19		827	7.1
Lafourche		361	6.5		365	1.1		333	-8.8
Plaquemines		126	-1.6		128	1.6		146	14.1
St. Bernard		178	-4.3		143	-19.7		146	2.1
St. Mary		161	67.7		124	-23		118	-4.8
Terrebonne		395	-7.3		40	6.3		407	-3.1

Parish	2000	Building	% Change	2001	Building	% Change
Jefferson		709	-14.3		754	6.3
Lafourche		285	-14.4		272	-4.6
Plaquemines		118	-19.2		125	5.9
St. Bernard		102	-30.1		126	23.5
St. Mary		96	-18.6		93	-3.1
Terrebonne		409	0.5		433	5.9

Louisiana Department of Economic Development, 2001

Hospitals and Healthcare

All six parishes have professional healthcare facilities. Jefferson Parish has the most hospitals, physicians' offices and other health care facilities, which would be expected since Jefferson has the largest population and the highest per capita income of the six parishes. Plaquemines Parish has facilities for the disabled, physicians and dentist offices, and home healthcare services but no hospitals or nursing care facilities. Table 20 presents project area hospital and healthcare statistics.

Table 20. Hospitals and Health Care Facilities.

Parish	Facilities for the Elderly & Disabled	Nursing Care Facilities	General Medical & Surgical Hospitals	Physicians Offices	Dentists Offices	Home Health Care Services
Jefferson	36	20	6	439	236	63
Lafourche	2	5	3	68	35	3
Plaquemines	2	0	0	6	3	3
St. Bernard	4	4	2	34	20	4
St. Mary	1	1	2	23	13	2
Terrebonne	7	5	3	67	35	10
Louisiana	242	314	141	3,270	1,519	418

United States Census Bureau, American FactFinder. (n.d.) (c)

SECTION 3. SOCIOECONOMIC IMPACTS OF THE BROWN MARSH PHENOMENON

This section presents a comprehensive analysis of anticipated the Brown Marsh Phenomenon (BMP) impacts considering the worst-case scenario - complete decimation. Discussion of the best-case scenario, complete recovery, is not presented because in that scenario the marsh would completely recover from any damages; as the marsh recovered all negative impacts would be restored. The mid-level scenario, the status quo, (no recovery but no further damage) is presented in Part Two of this report.

3.1 Potential Impacts - Summary

Table 21 presents a summary of the resources present in the project area that could be adversely impacted by the BMP. The value presented represents the sum of the statistics for the latest year available from all six project-area parishes.

Table 21. Impacts Summary.

ENVIRONMENTAL RESOURCES		
Resource	**Reference Year**	**Quantity**
Total Area	2001	6,369,015 acres
Total Land	2001	2,924,796 acres
Total Salt marsh	2001	512,509 acres
Farm Land	2001	319,820 acres
Crop Land	2001	162,894 acres
Threatened/Endangered Species	2001	42 species
State Parks	2001	1,291 acres
Wildlife Refuges	2001	76,353 acres
Wildlife Mgt Areas	2001	357,480 acres
Scenic Waterways	2001	38 miles
Scenic Roads	2001	309 miles
Festivals	2001	146
Historic Places	2001	90
Archaeological Sites	2001	1,350
Tourist Attractions	2001	64
Revenues from Tourism	2000	$1,189,070
Oil/Condensate Tax Revenues	2000	$111,228,964.86
Gasoline Tax Revenues	2000	$27,252,314.99
Timber/Pulpwood Tax Revenues	2000	$7,791.14
Mineral Tax Revenues	2000	$324,240.40
Sales Tax Revenues	2000	$273,722,622
SOCIOECONOMIC RESOURCES		
Population	2000	797,429 persons
Labor Force	2000	389,591 persons

3.2 Potential Land Impacts

3.2.1 Affected Acreage

There are approximately 2.9 million acres of land and 500,000 acres of salt marsh in the six-parish project area (Figure 1). Terrebonne has the greatest number of acres of land with 803,200 acres, which includes 155,541 acres of salt marsh (Table 22). In the worse-case scenario, total loss of all 99,603 acres of salt marsh as a result of the BMP, the residents of St. Bernard Parish would be the most adversely impacted, losing approximately 34 percent of their total acreage. Loss of all of the salt marsh would also impact the rest of the land in St. Bernard Parish and likely impacts the other parishes, though estimating exactly how many acres would be secondarily impacted is not within the scope of this report.

In addition, the Forest Protection Division of the Louisiana Department of Agriculture and Forestry, in 2000 reported that 4,738 fires resulted in a loss of 92,573 and 85 homes. Two notable fires in 2000 included a marsh fire in Vermilion parish that covered approximately 12,000 acres and a swamp fire that consumed more than 1,000 acres in Gramercy Swamp (Grandy, 2004).

In the best-case scenario, all marsh that was lost during the BMP would recover and there would be no net land loss. However, as discussed in Part Two, section 4.0, even with total land recovery there would be a significant economic loss associated with the BMP years 1998-2000.

Table 22. Land Loss Assuming 100 % Decimation of Salt Marshes.

Parish	Total Land (Acres)	Total Salt marsh (Acres)	Minimum Land Loss Assuming Total Salt Marsh Die Back
Jefferson	196,479	13,012	6.62%
Lafourche	694,400	139,581	20.10%
Plaquemines	540,799	104,772	19.37%
St. Bernard	297,599	99,603	33.47%
St. Mary	392,319	-	-
Terrebonne	803,200	155,541	19.37%
			Total Salt Marsh 512,509 acres

Center for Landscape Interpretation (n.d.)

3.3 Water Quality Impacts

Drinking water in the project area is obtained from the surface; there are no freshwater aquifers along the Louisiana coast. As a result the inhabitants of the project area depend upon the presence of the salt marshes as a barrier to saltwater intrusion. If all of the salt marshes in the project area were lost (the worst-case scenario), saltwater from the Gulf of Mexico would almost certainly contaminate the fresh surface water sources upon which the residents rely. Thus, in the event of complete salt marsh decimation, most if not all of the water typically used for drinking would be rendered non-potable. The effects saltwater intrusion as a result of marsh die-off and the resulting elevated chloride levels was well illustrated in Lafourche Parish in 2000, when

home drinking water contained three times the Federal drinking water standard of 250 parts per million. Valentine Paper was forced to temporarily shut down because their water source contained elevated chloride concentrations. Minor's Canal and Hanson Canal locks were forced to close because of the elevated chloride concentrations (up to 3,000 parts per million), which resulted in boat launch closures in Terrebonne Parish. Rice farmers lost much of their crop when their water wells were contaminated by chloride levels exceeding 1,000 parts per million (Grandy, 2004).

In addition, with the die off of the salt marshes, the barrier against saltwater intrusion into the other marsh types would be lost. As saltwater intruded into the brackish, intermediate and then into the fresh water marshes that exist behind and are protected by the salt marshes, most if not all of those marshes would die. Eventually the other marsh types could either be converted into salt marshes, or as a result of massive marshland loss the position of the coast could change. Loss of all coastal marshes in the project region would have devastating direct impacts on every resident of south Louisiana and would secondarily effect the rest of Louisiana and the possibly the nation.

3.4 Ecological Impacts

As discussed previously, ecological resources in the project area include state parks, wildlife refuges and wildlife management areas, and also include 42 threatened or endangered species. In the worse case scenario, all resources within the project could be adversely impacted and possibly irrevocably lost.

In their report, Evers *et al* (2003) elaborated on ecological impacts and concluded that five resident fishes, two resident reptiles, five resident birds, and four wintering birds could be adversely impacted by the changes in habitat and food sources associated with the 1998-2000 BMP. The researchers also concluded that these animals were likely to be more severely impacted by cumulative loss of salt marsh habitat than by the BMP alone (Evers *et al*, 2003).

Those species identified by Evers *et al* (2003) that are thought most likely to be impacted by the BMP are presented in Table 23.

Table 23. Species Most Likely to Be Adversely Impacted by BMP.

Resident Fishes	Resident Reptiles	Resident Birds	Wintering Birds
Diamond Killifish	Diamondback terrapin	Black-crowned night heron	Yellow rail
Sheepshead Minnow	Salt marsh snake	Reddish egret*	Black rail
Bayou killifish		Willet	Sora
Mosquitofish		Clapper rail	Virginia rail
Sailfin molly		Seaside sparrow*	

Evers *et al*, 2003
*Species is on the Audubon Watch list

3.5 Aesthetic Impacts

As discussed in Section 1.4, aesthetic resources in the project area include 38 miles of scenic waterways and 309 miles of scenic roads. In the worse case scenario, all resources within the project could be adversely impacted and possibly irrevocably lost.

3.6 Cultural Resource Impacts

Section 1.5 described archaeological, historical and recreational resources, festivals and tourist attractions in the project area. All of these resources could be adversely impacted by total salt marsh decimation.

3.7 Monetary Resources

In Section 1.6, revenues from tourism and sales taxes were discussed. From that section one can see that monetary resources would be severely impacted (initially) by total salt marsh decimation. Monetary impacts are an important consideration, though certainly not the only one, because loss of revenue is a concept to which most people immediately relate. As indicated in Table 18, loss of revenues in the worse case scenario could result in loss of more than $400 million annually in revenues from tourism and taxes. These effects would be cumulative for the duration of marsh die back phenomenon.

Monetary impacts from the perspective of an economist are presented in Part Two of this report.

3.8. Social Impacts

In the event of total salt marsh dieback, roughly 800,000 people, the approximate population of the six-parish project area, could be adversely impacted. Direct impacts to coastal families could include loss of homes and property due to land loss. Secondary impacts could include increased stress when families are displaced. Inland residents could also experience secondary adverse impacts including an influx of new residents, increased competition for employment, shortages of wild game and increased seafood prices.

Total salt marsh die back could have an extreme impact on the residents of the project area with respect to employment. The median age of the residents of the project area is approximately 35 and approximately 18 percent of the project area residents subsist at or below the poverty level. Approximately eight percent of the project area residents are not high school graduates; on average four percent do not complete 9^{th} grade. Because of the culture of south Louisiana and the prevalence of wildlife it is likely that the land supports many of the residents via fishing, hunting, trapping, farming, etc. In the absence of marshlands, many of the people in the project area would have to seek other means to make a living; it would be reasonable to assume that some might have to depend upon government assistance, at least in the short term.

PART TWO – AN ECONOMIC APPROACH

This part describes the socioeconomic impacts of the Brown Marsh Phenomenon (BMP) from the viewpoint of an economist/economics educator.

SECTION 4. ECONOMIC IMPACTS OF THE BROWN MARSH PHENOMENON

4.1. Introduction

The purpose of this introduction is to present an explanation for the market value of salt marsh as real estate. "Market value" does not exhaustively represent the value of a salt marsh because market imperfections overlook much of the value of a marsh. The first step towards assigning value to a marsh is to identify the benefits that are appropriately valued and those that are not. The next step is to further define the benefits and actually place values on them. Placing economic values on marsh benefits requires finding ways to estimate what people would be willing to pay for a given benefit if there were no market imperfections. The nature of the benefit determines the approach that can be used.

The value of a salt marsh includes a variety of disparate benefits from fully marketable to intangible. Marshland is subject to private ownership and therefore has a market value. The market value represents rival, excludable benefits including the right to use the land, generally including mineral and surface rights, and the right to exclude others. The greatest value of salt marshes, however, lies almost entirely with non-rival, non-excludable, and often off-site benefits that the market does not value.

To develop a value for marsh, it is necessary to break it down into its component benefits, categorize those benefits, and establish values for them. The off-site benefits of marshes have a direct impact on the commercial fishing, hunting, trapping and aquaculture industries in the estuarine region. These estuary-dependent industries benefit from the productivity of the marshes, but because biological productivity is non-excludable and mainly off-site, the market fails to associate the economic value of their industries with the associated land. Similarly, the marshes and their inherent productivity also support the recreation and tourism industries, primarily characterized by recreational fishing, hunting, and touring. These economic impacts further stimulate the local economy. Marshes also provide non-rival and non-excludable benefits, such as storm protection and water quality benefits. The market does not value these off-site, positive externalities, nor do they have a direct economic impact, yet there are undisputed marsh benefits. Finally, coastal marshes have value as components of the history and culture of a region. In Louisiana we value our culture and history and marshes have played and continue to play a prominent historical role.

For the purposes of this discussion both “goods” and “services” are described by the term “good" and "salt marsh" is implied where not directly stated.

4.1.1 Market Imperfections in Assigning Value

Evaluating the social and economic impact of marsh die back starts with a discussion of how we as a society understand the concept of “value.” While value means different things to different people, we most often understand value to represent the monetary equivalent of a good. Through the process of buying and selling, prices are established that represent the economic value of a particular item. If, for example, one wanted to know the value of a car, one might look at the

Blue Book prices, or sale advertisements of similar cars in the newspaper. From this perspective, the value of a good is set by prices in the market place; the prices reveal what people have been willing to pay for a good. This is market value.

The market measures the benefits that purchasers perceive they can derive from a good. Generally, the more benefits that can be derived, the more purchasers will be willing to pay. The market's ability to determine value, however, only works to the extent that it can measure all of the benefits that comprise a given good. The market, however, does not measure some benefits, resulting in what economists call market imperfections. The effect of market imperfections is that the market price of a given good may be less than the sum of the benefits, thus the good is undervalued.

4.1.1.1 Competitive exchange – rival and excludable goods

One reason that market imperfections occur is because the market only values benefits that can be competitively exchanged, *i.e.* rival or "competitive goods." When one purchases a rival good that purchase reduces the supply of the good. "Non-rival goods" are not competitively exchanged; the use of the good does not reduce its total supply. Non-rival goods are not valued as much as competitive goods because their supplies are not limited; a non-rival good has value but not much market value. The air that we breathe is a non-rival good because it cannot be competitively exchanged and our use does not meaningfully reduce the supply. At this point in history our air supply is a non-rival, non-competitively exchanged good.

Another element of competitive exchange is the ability to control a good, to exclude others from using it unless they pay for it. Economists refer to this concept as "excludability." A benefit is considered non-excludable when the cost associated with excluding people from owning it exceeds the benefit that could be derived from that good. No one is willing to pay for a good or service if they can get it for free. The air that we breathe is a non-rival good because use does not appreciably reduce the total amount available and non-excludable because it would be too difficult to charge people to use it. If a good does not have an associated cost there is no market price for it. Air is nonetheless extremely valuable.

Goods that are both non-rival and non-excludable are often referred to as "public goods," i.e. state-owned parks. Goods can also be rival but non-excludable. Fishing in public is one example of a rival and non-excludable resource.

4.1.1.2 Externalities

Non-excludable benefits are often deemed as off-site benefits because the benefits occur away from the site; economists refer to off-site benefits as "externalities." A forest has many rival, excludable, and therefore marketable benefits such as the land and timber, but it also has non-rival, non-excludable benefits as well. Watershed functions, oxygen creation via photosynthesis, species habitat, and scenic views are examples of externalities associated with a forested area. Because they are non-excludable, there is no distinct market price, and their values are therefore external to the market-valuation process.

Externalities are not always beneficial. Clear-cutting timber can create negative externalities including detrimental impacts to the surrounding watershed and loss of the support matrix that holds the soil in place, both of which may contribute to land loss. A detrimental externality does not necessarily influence the market value of a good.

4.1.1.3 Time: Multi-generational benefits

The time that it takes for benefits to increase also may have an impact on the market value of a good. Because the market establishes prices based on the perception of derivable benefits, if the accumulation of benefits is perceived as too far off into the future, the market will reduce the value of the good or not value the good at all. If a good is perceived as having some benefit now but mostly benefiting future generations, most individuals do not significantly value that good. The value of long-term sustainable ecosystems is one example of a multi-generational benefit. As human social and cultural development continues it can be expected that natural systems will be more valuable for future generations. However, because those generations are not here to participate in the current market, the market does not consider the value that future generations would place on future benefits.

4.1.1.4 Intangibles

The market does not take into account a variety of unique and intangible benefits. Intangible benefits are wholly non-rival and non-excludable and not subject to competitive exchange. Intangibles describe concepts of relative worth, importance or significance that enhance value. The cultural and sentimental values that we often associate with objects and places are not easily convertible into economic values, although they are worth something to us. The intangible benefits presented in this chapter are more than matters of preference; they are issues of personal and public significance that are difficult to measure in economic terms. As with all other non-market value benefits, because they are difficult to measure using economic terms does not mean that they are valueless.

4.2 Economic Effects - Value and Marsh

Although the values established for estuarine dependent industries and recreation represent actual expenditures in the local economy, when revenue of either enters a regional economy, the revenue will stimulate growth in connected industries. The cycle of stimulation, referred to as a multiplier effect, continues until the input revenue leaves the local economy, either through savings or spending outside the regional economy. Where there are decreases in economic output, the cycle occurs in reverse.

Economic input/output (I/O) models are used to gauge and predict the industry dependencies and subsequent economic effects on industrial output, employment and consumer spending. In particular, I/O models track three classifications of effects: direct effects, indirect effects and induced effects. Direct effects are the initial economic changes in primary or directly-related industries. Indirect effects are the changes that occur in secondary industries as a result of economic changes in primary industries. Induced effects are the changes that occur as a result of both direct and indirect effect.

4.2.1 Direct Economic Benefits

Estuary-dependent commercial industries benefit from and generate revenue that is linked to marsh productivity. The revenues generated by these industries can be used as an indication of the economic value of a marsh. Recreational activates, including fishing, hunting and eco-tourism benefit from both the productivity and the existence of the marsh. Estimating the amount that people spend or are willing to spend on the recreational activity can be used to estimate the value of these estuary-dependant benefits. Estuary-dependent industries and recreation have a direct economic impact on the local and regional economies and secondarily impact the region by stimulating economic development in other industries. Both direct and indirect estuary-dependant economic effects must be considered when assigning value to the marsh.

The six parishes in the salt marsh project area support several industries that are uniquely and directly dependent on the productivity of salt marshes. Because the productivity of these industries is linked to marsh productivity, the revenue that is generated by these industries can be used to estimate the economic value of this productivity benefit. Of particular interest are commercial fishing, hunting and trapping, and aquaculture. Other industries in the region, including oil and gas extraction and shipbuilding, benefit from the existence of marshland though their marsh-derived benefits are primarily storm surge and flood protection, the value of which will be described later.

4.2.1.1 Commercial Fishing

Commercial fishing including both freshwater marine fisheries, is a significant economic activity in the State of Louisiana, generating approximately $300 million in direct revenue over a 2-year average. The six parishes comprising the study area, Jefferson, Lafourche, Plaquemine, St. Bernard, St. Mary and Terrebonne, were the source of over 65 percent of the combined fisheries revenue generated in the state, totaling more than $200 million dollars annually. In particular, the region was responsible for more than three quarters of the marine fishery, including most of the $177 million shrimp catch and most of the $30 million dollar finfish catch. Table 24 presents Commercial Fisheries Revenues for 1999-2000 (Louisiana Cooperative Extension Service, 2000).

4.2.1.2 Commercial Hunting and Trapping

Fur trapping is historically and culturally significant in Louisiana, although trapping contributions to the economy are now relatively minor. Trapping activities are reported by the value of the pelts and meat. In 1999 trapping yields were comprised of 82 percent nutria, 11 percent raccoon, and the remaining 7 percent in mink, opossum, river otter, fox, bobcat, beaver, and coyote. While fur prices were stable and relatively strong for the state in 1996-1997 and 1997-1998 and generated about $3.5 million in revenues annually, the market price decreased in 1998-1999 and trappers grossed only about $549,000. Revenues from the six-parish project area comprise about one half of the entire state production and value for pelts and meats (Louisiana Cooperative Extension Service, 2000).

Table 24. Commercial Fisheries Revenues; 1999-2000 annualized average in 2000 Dollars.

	State	Project Area	Region % of State
FRESHWATER FISHERIES			
Crawfish (Wild)	$16,795,763	$2,706,470	16.11 percent
Catfish (Wild)	$3,887,180	$743,948	19.14 %
Buffalo	$767,137	$2,535	0.33 %
Gar	$761,371	$200,924	26.39 %
Other Finfish	$455,749	$22,068	4.84 %
Freshwater Fisheries (Total)	$22,667,200	**$3,675,945**	**16.22 %**
MARINE FISHERIES	**State**	**Project Area**	**Region % of State**
Shrimp	$177,332,894	$137,174,644	77.35 %
Menhaden	$53,131,355	$18,699,075	35.19 %
Crabs	$27,221,046	$16,750,753	61.54 %
Commercial Finfish	$31,778,741	$30,047,528	94.55 %
Marine Fisheries (Total)	$289,464,036	$202,672,000	70.02 %
TOTAL FISHERIES	$312,131,236	**$206,347,945**	**66.11 %**

Louisiana Cooperative Extension Service; 2000.

Wild alligator is Louisiana's most significant commercial game animal, generating the bulk of the state's commercial hunting and trapping revenue. Prices for alligator have been stable, generating about $3.5 million in average revenue statewide. Forty-five percent of the states alligator hunting and trapping revenue, approximately $1.65 million annually, is generated in the project area (Table 25).

In summary, approximately one-half of the states hunting and trapping revenue originates from the project area. This revenue is an appropriate measure of marsh value; the two-year annualized value of hunting and trapping in the project area marshes, averaged in year 2000 dollars, is $2.5 million.

4.2.1.3 Aquaculture

Commercial aquaculture species in Louisiana include catfish, crawfish, oysters, crabs, and farmed alligators. The aquaculture industry as a whole has been in decline for the past several years, with the exception of crawfish farming and oyster seeding. The project area produced about 30 percent of the 1999-2000 statewide $140 million aquaculture revenue (Table 26).

4.2.1.4 Recreational Activities

Louisiana, known colloquially as "The Sportsman's Paradise," offers substantial outdoor or nature-based recreational activity and much of this activity is centered in the project area. Recreational activities, unlike commercial hunting, fishing and aquaculture, do not have a market component that can be used to measure value to the consumer. One common way to value a

Table 25. Commercial Hunting & Trapping; 1999-2000 annualized average in 2000 Dollars.

FUR ANIMALS	State	Project Area	Region percentof State
Pelts	$1,570,991	$799,481	50.89 %
Meat	$199,088	$55,434	27.84 %
Fur Animals (Total)	$1,770,079	**$854,915**	48.30 %
ALLIGATORS			
Wild	$3,611,452	$1,657,849	45.91 %
Total Hunting & Trapping	$5,381,531	**$2,512,764**	**46.69 %**

Louisiana Cooperative Extension Service, 2000.

Table 26. Aquaculture Revenues; 1999-2000 annualized average in 2000 Dollars.

	State	Project Area	Region % of State
AQUACULTURE			
Crawfish (Farm)	$25,370,362	$1,400,179	5.52 %
Catfish (Farm)	$54,097,210	$23,280	0.04 %
Minnows	$2,698,155	-	
Baitfish	$1,821,364	$869,136	47.72 %
Alligators (Farm)	$10,537,126	$3,357,104	31.86 %
Oysters	$40,953,977	$34,274,426	83.69 %
Soft-shell Crabs	$2,058,057	$1,258,044	61.13 %
Other Species	$6,824,372	$927,643	13.59 %
Aquaculture (Total)	$144,360,623	**$42,109,812**	**29.17 %**

U.S. Department of the Interior, 1996.

marsh in terms of recreational value is to ask people how often they utilize recreational opportunities and how much they have actually paid in those pursuits. In this discussion we will use this approach both to take advantage of existing research data and because this method estimates activity via actual expenditures.

Since 1955, the US Fish and Wildlife Service has gathered and archived data on outdoor/nature-based recreational spending. The most recent survey (1996) reports the extent of recreational expenditures by state. Use of this data, combined with data from Louisiana recreational licenses and data from the National Marine Fisheries Service, enables us to estimate the average amount of recreational utilization, a total expenditure, and a value per day, per consumer, for a given recreational activity. This approach allows us to place an economic value on recreational fishing, hunting and touring (U.S. Department of the Interior, 1996).

4.2.1.5 Recreational Fishing

The most current data available for recreational fishing and hunting are from 1996. In 1996 more than one million people over age 16 engaged in recreational fishing in Louisiana. Of those, 85 percent were Louisiana state residents; 15 percent were from out of state. Both in-state and out of state anglers spent $873 million on fishing related expenses and $407 million on travel expenses, including food, lodging, transportation, bait, and fuel. These anglers spent a total of 21 million days fishing in the state of Louisiana; approximately 23 days per freshwater angler, and 6 days per saltwater angler. With these survey estimates of total expenditures per salt-water and fresh-water angler and the average number of recreational days per angler, one can estimate the amount of money spent per fishing day on recreational fishing in Louisiana. Using these values, we calculated that in 1996, freshwater anglers spent $14.42 to $27.65 per recreational day and salt-water anglers spent $61.99 to $89.63 per recreational day in the state of Louisiana. The recreational and financial importance of fishing in Louisiana is apparent (Tables 27 – 33; U.S. Department of the Interior, 1996; Louisiana Cooperative Extension Service, 2000).

Table 27. Saltwater Anglers, Trips, and Days of Fishing: 1996.

Details	TOTAL		State residents		Nonresidents	
	Number	Percent	Number	Percent	Number	Percent
Total anglers	346	100	255	74	*91	*26
Total trips	1,667	100	1,449	87	*218	*13
Total days of fishing	2,083	100	1,849	89	*234	*11
Average days of fishing	6		7		*2.6	

U.S. Department of the Interior, 1996 *and* Louisiana Cooperative Extension Service, 2000.
Population 16 years old and older. Detail does not add to total because of multiple responses.
* Estimate based on a small sample size.

Table 28. Freshwater Anglers, Trips, and Days of Fishing: 1996.

Details	TOTAL		State residents		Nonresidents	
	Number	Percent	Number	Percent	Number	Percent
Total anglers	815	100	697	86	*118	*14
Total trips	13,498	100	13,218	98	*280	*2
Total days of fishing	18,493	100	18,073	98	*420	*2
Average days of fishing	22.7		25.9		*3.6	

U.S. Department of the Interior, 1996 *and* Louisiana Cooperative Extension Service, 2000.
*Estimate based on a small sample size.
Detail does not add to total because of multiple responses.

Table 29. Summary of Trip and Equipment Expenditures in the State for Freshwater Fishing.

Details	Amount	Average per Angler	Average cost per angler per Day	Adjusted to Year 2000 dollars
Food and lodging	$100,362	$123	$5.35	$5.67
Transportation	$55,058	$68	$2.94	$3.11
Other trip costs	$99,794	$122	$5.32	$5.64
Total trip	**$255,214**	**$313**	**$13.62**	**$14.42**
Equipment	$234,249	$287	$12.50	$13.23
Total trip plus equipment	**$489,463**	$601	$26.11	**$27.65**
Total anglers	815			
Days per angler	23			

U.S. Department of the Interior, 1996 *and* Louisiana Cooperative Extension Service, 2000.

Table 30. Summary of Trip and Equipment Expenditures in the State for Saltwater Fishing.

Details	Amount	Average per Angler	Average cost per angler per Day
Food and lodging	$44,872	$130	$21.61
Transportation	$25,889	$75	$12.47
Other trip costs	$57,922	$167	$27.90
Total trip	**$128,683**	**$372**	**$61.99**
Equipment	$57,399	$166	$27.65
Total	**$186,082**	$538	**$89.63**
Total anglers	346		
Days per angler	6		

U.S. Department of the Interior, 1996 *and* Louisiana Cooperative Extension Service, 2000.

Table 31. Recreational Fishing Licenses.

	PARISH								
	Jefferson	Lafourche	Plaquemines	St. Bernard	St. Mary	Terrebonne	Region	State	Region as % of State
Number	115,973	66,424	26,436	30,296	22,214	62,344	323,687	1,023,455	32 %

U.S. Department of the Interior, 1996 *and* Louisiana Cooperative Extension Service, 2000.

Table 32. Marine Recreational Fishermen Survey, 1997-2000.

Year	Coastal Residents	Non-Coastal Residents	Out-of-State Residents	Total
1997	471,045	48,795	95,750	615,590
% total for 1997	76.50 %	7.90 %	15.60 %	100.00 %
1998	434,040	41,095	106,071	581,206
% total for 1998	74.70 %	7.10 %	18.30 %	100.00 %
1999	409,175	33,115	90,648	532,938
% total for 1999	76.80 %	6.20 %	17.00 %	100.00 %
2000	533,479	64,391	101,670	699,540
% total for 2000	76.30 %	9.20 %	14.50 %	100.00 %
Average 97-00	76 %	8 %	16 %	100 %

National Marine Fisheries Service, April 2001.

Table 33. Regional Recreational Fisheries Value.

				Expenditure Range*		Annual Value Range	
Fishery Type	Fishing Days in State	% Licenses in Region	Regional fishing days	Lower	Upper	Lower	Upper
Fresh	18,493,000	32 %	5,917,760	$14.42	$27.65	$85,334,099	$163,626,064
Salt	2,083,000	32 %	666,560	$65.64	$94.92	$43,755,136	$63,269,875
Total	**20,576,000**		**6,584,320**	**$80.06**	**$122.57**	**$129,089,235**	**$226,895,939**

U.S. Department of the Interior, Fish and Wildlife Service.
*In 2000 dollars, GDP deflator inflation index - 5.9 %

4.2.1.6 Recreational Hunting

There were 352,000 resident and nonresident hunters aged 16 and over in Louisiana in 1996. Hunters accounted for 6.8 million days of hunting, averaging 19 days per hunter. Ninety-two percent were Louisiana residents. Hunting expenditures for 1996 totaled $577 million; $368 million was spent on travel expenses and $208 million on equipment expenses. White tailed deer hunting was most significant, accounting for about 50 percent of all hunting days and much of the states' $36.6 million in hunting lease revenue. Only 3.9 percent of state lease revenue was generated in the project area (Tables 34 and 35) (U.S. Department of the Interior, 1996; Louisiana Cooperative Extension Service, 2000).

Table 34. Hunters and Days of Hunting In-State, by Type of Game, 1996.

Type of game	Hunters - state residents and nonresidents		Days of hunting	
	Number	**Percent**	**Number**	**Percent**
Deer	228,000	65	3,313	49
Big game, total	**228,000**	65	**3,348**	50
Rabbit, hare	149,000	42	1,069	16
Squirrel	191,000	54	1,887	28
Small game, total	**340,000**	70	**2,377**	35
Duck	*111	*32	*580	*9
Dove	*58	*16	*266	*4
Migratory birds, total	**169**	40	**846**	13
Total, all types of game	**352**	100	**6,571**	100

U.S. Department of the Interior, 1996; U.S. Louisiana Cooperative Extension Service, 2000.
Population 16 years old and older.
* Estimate based on a small sample size.

Table 35. Expenditures in the U.S. by State Residents for Hunting, by Type of Hunting, 1996.

		Total, all Hunting			
		Amount	**Average per hunter**	**Average cost per hunter per day**	**Adjusted to Year 2000 dollars**
Food and lodging		$49,060,000	$139	$7.34	$7.77
Transportation		$44,005,000	$125	$6.58	$6.97
Other trip costs		$37,960,000	$108	$5.68	$6.01
Equipment & Costs		$237,349,000	$674	$35.49	$37.58
Total trip		**$368,374,000**	**$1,047**	**$55.08**	**$58.33**
Aux Equipment		$208,717,000	$593	$31.21	$33.05
Total Hunters	352,000				
Average # hunting days	19				
Total		**$577,091,000**	**$1,639**	**$86.29**	**$91.38**

U.S. Department of the Interior, 1996; Louisiana Cooperative Extension Service, 2000.
Population 16 years old and older

Using the same methodology as we used to estimate fishing revenues to estimate project area hunting revenues, recreational hunting licenses in the project area accounted for 12 percent of the state total. The average expenditure for hunters, in 2000 dollars, ranged from $58.33 to $91.38 per day. The range is influenced by revenues for auxiliary equipment, which may or may not be used for other purposes, and which accounted for 57 percent of total hunting expenditures.

Multiplying the per-day expenditure ranges by the number of hunting days per hunter in the six-parish region results in a range of total annual recreational hunting value of $47,289,298 to $74,083,594 for the project area (year 2000 dollars; Table 36).

Table 36. Total Regional Hunting Value.

Hunting Days in State	% of Licenses in Region	Regional hunting days	Expenditure Range*		Value Range	
			Lower	Upper	Lower	Upper
6,756,000	12 %	810,720	$58.33	$91.38	$47,289,298	$74,083,594

U.S. Department of the Interior, Fish and Wildlife Service, 1996.
*In 2000 dollars, with GDP deflator inflation index -- 5.9 %

4.2.1.7 Eco Tourism - Recreational Nature Touring

Wild life watching, nature touring or eco-tourism includes activities such as observing, feeding, watching, and photographing wildlife and nature areas. In 1996, 260,000 Louisiana residents traveled more than one mile from their homes to participate in eco-tourism and spent $61,429,000 on travel expenses alone. In addition, 876,000 Louisiana residents spent $137,250,000 on equipment for eco-tourism (Louisiana Cooperative Extension Service, 2000).

A reasonable estimate of the value of eco-tourism in the project area was estimated based upon the percentage of the state population in the study area. Approximately 796,000 people, 18 percent of the state's population of 4.4 million, reside in the study area. The annual average eco-tourism expenditures divided by the regional population estimates results in an approximate annual eco-tourism value range of $19,301,640 to $65,031,682 (year 2000 dollars; Tables 37 and 38).

Table 37. Eco-Tourism Calculations.

		Amount	Average per tourist
		Eco Tourism Related Travel Expenses	
Food and lodging		$38,589,000	$148
Transportation		$12,891,000	$50
Other trip costs		$9,949,000	$38
TOTAL		**$61,429,000**	**$236**
Traveling Eco Tourists	260,000		
		Local Eco Tourists	
Equipment		$137,250,000	$157
Local Eco Tourists	876,000		

Louisiana Cooperative Extension Service, 2000.

Table 38. Regional Eco-Tourism Value.

State population	Region population	% Regional pop	Annual average trip costs per tourist	Annual Average equipment cost per tourist
4,468,976	797,429	17.84 %	$236.27	$156.68

Statewide Eco Tourists	Regional Eco Tourists	Expense	Value Range		Year 2000 Dollars*	
			Upper	Lower	Upper	Lower
260,000	46,3894	**Trips**	$18,226,289.76		$19,301,640.86	
876,00	156,278	**Equipment**		$61,408,576.28		$65,031,682.28

Louisiana Cooperative Extension Service, 2000.
*GDP deflator inflation index -- 5.9 %

4.2.2 Indirect Economic Benefits

The first part of this discussion, Direct Economic Effects, discussed marsh benefits that generated direct revenue for the local economy. In our calculations for direct economic benefits, we were able to use revenue as a measure of the economic value of the benefits to the local economy. However, there are additional important marsh benefits that do not generate any direct revenue but provide valuable benefits nonetheless. Storm protection and water quality benefits are non-excludable marsh benefits whose value must be estimated in a different way. We recognize these benefits as valuable and if we were to lose the marsh the benefit would have to be supplied in some other way. Since marshland provides natural storm protection, the cost of providing storm protection if the marsh were gone can be used to estimate the value of the marsh benefit. However, the benefit must be used to have value. For instance, water treatment benefits of a marsh are valuable, but if the pollution levels in the water vastly exceed the marsh's capacity for purification, applying a full value to all acres of the marsh would be inappropriate. Also, because the services that a marsh provides are free, in the sense that one does not have to pay a direct fee for their use, an economic alternative might not be an accurate measure of value. People may give up the benefit rather than pay for it. For example, if, in the absence of marsh protection, the cost of protecting a camp in the marsh was too high, the owners might abandon the camp, rather than pay for protection. This example illustrates that when estimating economic value, the upper limit of value is a person's actual willingness to pay (Costanza *et al*, 1989).

A more difficult set of benefits to calculate are those that do not have a perceptible unit of measure. For instance, marshes provide storm protection and water purification for local and regional communities. Both services are important but assigning an actual monetary value would be difficult, though one possible option would be to estimate the cost of providing the service in an alternative manner.

4.2.2.1 Water quality benefits

The value of Louisiana wetlands as a provider of water purification benefits has been specifically addressed in over a dozen research projects. The results have ranged from as little as $2.85/acre to $5673.80/acre; a reasonable estimate has placed the median and mean values of the marsh at $323.05 acre/year and $178.64/acre/year, respectively. Additionally, a review of willingness-to-pay surveys consistently placed benefits in the range of $65/acre annually. An important and

overriding consideration raised by the wide range of values and by Richard Kazmieczak's paper is that the specific location of the marsh and its potential for water purification use has a dramatic impact on the marsh value. Essentially, where there is an economically beneficial use, such as municipal or industrial wastewater treatment, the value is higher because people's willingness to pay is higher (Table 39) (Kazmierczak, May 2001).

Table 39. Water Quality Value Calculations.

Base Acreage	Per Acre Value Estimates		Willingness to Pay Estimate	Value Range		Adjusted to Year 2000 Dollars	
	Lower	Upper		Lower	Upper	Lower	Upper
500,000	$178.64	$323.05	$65.00	$121,820,000	$194,025,000	$129,007,380	$205,472,475

Kazmierczak, Jr., 2001.
*GDP deflator inflation index -- 5.9 %

4.2.2.2 Storm Protection

Coastal Louisiana is heavily dependant upon marshes for storm protection. Interior fresh marshes and swamps provide flood protection, while salt marshes provide storm surge and wave protection. Salt marshes act as barriers during storm events, absorbing water and wave energy and protecting coastal infrastructure. It is generally accepted that every mile of vegetative wetlands reduces storm surge by one foot. There are a variety of reasonable methods for placing a value on the marshes function in storm surge protection. It would be reasonable to use a willingness-to-pay approach to estimate the economic value of protection via the marsh because most people in the coastal zone are aware of storm risks and value of the protection afforded by the marshes. The value of storm protection could also be estimated by both the value of the protected infrastructure and by the cost of constructing alternative protective structures, including levees. This type of calculation can be cumbersome because the value of the protected infrastructure must be estimated in addition to the value of the alternative protective structures. Finally, the published value of $236.20/acre, obtained by Constanza and Farbers in their Avoided Property Damage calculations, adjusted to year 2000 dollars, is a reasonable value to assign to salt marshes in terms of their storm protection function (Table 40) (Kazmierczak, May 2001; Costanza and Farber, 1987; Costanza *et al,* 1989).

Table 40. Storm Surge Value Calculations.

Base Acreage	Per Acre Value Estimates		Value Range		Adjusted to Year 2000 Dollars	
	Lower	Upper	Lower	Upper	Lower	Upper
500,000	$185.53	$905.00	$92,765,000	$452,500,000	$98,238,135	$479,197,500

Costanza and Farber, 1987; Kazmierczak, Jr., 2001; Costanza *et al,* 1989.
*GDP deflator inflation index -- 5.9 %

4.2.3 Intangible Economic Benefits

The most difficult set of marsh benefits to calculate do not generate direct revenue and do not have economic alternatives. These intangible benefits are primarily comprised of the marsh benefits to our culture and history. In Louisiana, substantial emphasis is placed on these benefits, to the extent that historical sites, museums, parks, cultural festivals, and even our judicial system intrinsically indicate economic values of these benefits that, with caution, we can measure.

The Acadians who began settling the region in the 1750s established cultural traditions that developed from the natural production cycle of Louisiana's natural resources. The wetlands, waterways and the wildlife that they support are a component of the cultural and historical heritage of south Louisiana in general and the six-parish project area in particular. People in the region annually celebrate approximately 80 festivals, 46 percent of which are focused on the areas cultural link to natural resources. Festivals include the blessing of the Shrimp Fleet, fishing rodeos, numerous seafood festivals, and Cajun and French ancestry festivals. Additionally, the Louisiana National Register of Historic Places lists nearly one hundred separate locations the project area. Based upon the time and emphasis placed on celebrating it, the regional history and culture are benefits that residents value. It is difficult to place a monetary value on these benefits (Jefferson Convention and Visitors Bureau; Houma Office of Tourism; Plaquemines Parish Tourism; Lafourche Tourist Commission; St. Bernard Tourist commission 2001).

The economic value of an intangible benefit could be characterized by how much more one is willing to pay for one intangible benefit versus another intangible benefit. For a marsh, the question could be, assuming all resource production values are equal, how much more is a resident of south Louisiana willing to pay for coastal marsh versus a non-marsh ecosystem, *e.g.* a forested area?

A better approach might be to consider a marsh landowner who benefits economically from the rival and excludable benefits that market prices measure. If some portion of the landowner's marsh is destroyed through the fault of another, will the owner attempt to recover damages in the form of compensation for marsh loss or will the landowner attempt to recover sufficient damages to repair or replace the lost marsh? Because a wetland will only sell for market value, a restored wetland, no matter what the costs of restoration, can still only sell for market value. Under these circumstances an owner of impacted or destroyed marsh who seeks damages to be used to restore their property must value their property more than market value. However, while the owners' choices can provide an indication of intangible marsh value, more informative is the type of damages the judicial system will bestow. The value of a marsh as indicated by the damages awarded in the judicial system can give an indication of society's intangible marsh benefits and values. Limiting recovery to market value denies consideration of intangible benefits, while allowing restoration cost damages recognizes those benefits.

The general rule for property damage recovery in Louisiana is that when a person suffers property damage at the fault of another, he is entitled to recover damages for either the

diminution in market value as a result of the harm or to recover the cost of restoration of the property. However, to receive restoration damages, the cost of restoration cannot be disproportionate to the market value of the property or be economically wasteful, unless there is a personal reason for the owner to restore the property to the original condition, and good reason to believe that the owner will in fact restore the property. This damage rule was recently applied in *St. Martin v. Mobile Exploration & Production U.S., Inc*. (2000) to a scenario in which a landowner alleged marsh damage and sought restoration damages rather than diminution in value damages. The market value diminution of the property was $245 per acre, and the restoration estimate was $10,000 per acre. The court stated the rule as: "restoration damages in excess of property value are available only where there is 'a reason personal to the owner for restoring the original condition or there is a reason to believe that the plaintiff will, in fact, make the repairs.'" The court ultimately found for the landowner, having been convinced that the marsh held "personal significance [to the landowner] warranting greater than market value damages," as well of the landowners desire and intent for restoration (*St. Martin v. Mobile Exploration & Production U.S., Inc*. 2000; *Roman Catholic Church v. Louisiana Gas Service, Co.* 1993*).*

Allowing recovery for property damage to exceed market value of the property where there is special interest and intent to repair recognizes the economic value of intangible benefits. These benefits are recognized as being worth the monetary difference between market value per acre and restoration cost per acre, even though the economic value of the property will still be capped at market value once restoration is completed.

Unless the scientists conducting research into the causes of the BMP indicate otherwise, dieback did not occur because of someone's negligent actions. However, the legal concepts presented above can be used to assist in valuing the intangible benefits of damaged or lost marsh. Marsh restoration estimates are site-specific in that the conditions, methods, materials, distance from people and material source all impact restoration costs. Since restoration cost estimates are a study in themselves, the secondary author proposes that restoration cost estimate per acre of wetland of $15,000 per acre can be used. This restoration cost, which the secondary author believes represents a conservative estimate, will be used throughout the remainder of this report. It is important to note that the restoration cost is an economic measure of theoretical value; it provides a *guideline* for what intangible benefits might be worth. The restoration cost estimate does not state what a marsh is actually worth or what the actual restoration costs might be for an actual restoration project. The actual costs vary according to market and site conditions.

4.3 Cumulative Value and Value per Acre

The previous sections have identified and estimated economic values for marsh benefits. To determine the impact of the BMP one must establish marsh value on a per-acre basis. To do so requires calculating the economic benefit of the marsh to the entire resource area then dividing the total marsh value by the acreage of the area. The result is a per-acre resource benefit value. There is however an inherent uncertainty in this calculation because the nature and extent of the biophysical links between marsh viability and the benefits discussed previously are uncertain. Nevertheless, studies have generally assumed a direct relationship between lost marsh acreage and adverse economic impact.

The resource area for this study is the six-parish project area, which contained approximately 1.6 million acres of marsh prior to the 1998-2000 salt marsh die off episode (Table 41). Of this, approximately 500,000 acres were salt marsh. As presented below in Table 42, the cumulative lower and upper range annual marsh benefit values, $673,896,210 and $1,301,651,711 respectively, divided by the approximate acreage of salt marsh in the project area, results in a marsh value range of $1,348 to $2,603 per acre.

Table 41. Total Marsh Acreage.

Parish	Total marsh	Saline	Brackish	Intermediate	Fresh
Jefferson	110,669	13,012	21,642	36,367	39,648
Lafourche	422,339	139,581	70,547	52,664	159,547
Plaquemines	51,674	104,772	100,961	192,220	118,121
St Bernard*	200,827	99,603	96,662	-	4,562
St Mary	433,316	-	271,029	6,924	155,363
Terrebonne	653,675	155,541	137,775	81,323	279,036
Total	**1,872,500**	**512,509**	**698,616**	**369,498**	**756,277**

T. Michot, 2001; Coastal Environments, Inc., 2001.

Table 42. Total Area Benefits.

	Value Range	
Quantifiable Benefit	**Lower**	**Upper**
Commercial Fishing	$206,347,945	
Commercial Hunting	$2,512,764	
Aquaculture	$42,109,812	
Recreational Fishing	$129,089,235	$226,895,939
Recreational Hunting	$47,289,298	$74,083,594
Eco-tourism	$19,301,640.86	$65,031,682
Water Quality	$129,007,380	$205,472,475
Storm Surge	$98,238,135	$479,197,500
Total Annual Benefits Value	**$673,896,210**	**$1,301,651,711**
Base Acreage	500,000	500,000
Per Acre Benefits Value	**$1,347.79**	**$2,603.30**

4.4. Loss Calculations – Three Scenarios

The brown marsh phenomenon has almost exclusively impacted the salt marshes in the project area. The total affected area has reached a high of approximately 112,000 acres, or approximately 27 percent of the salt marsh in the entire project area. The range in the impact value estimates for the BMP is a reflection of the uncertainty of whether or not the impacted acres will recover. Although as of 2001 some recovery had occurred, there is no absolute way to

predict if and to what extent the recovery will continue. In addition, impacts are likely ongoing and cumulative.

Theoretically, there are best and worst case scenarios, and there is the status quo. The best-case scenario would entail a complete recovery of the affected marsh, the worst case would entail compete decimation of saline marsh, and the status quo would entail no additional loss or recovery from this point forward. Each of these scenarios involves economic loss to different degrees.

The presently available (2001) data on salt marsh loss only spans five months, from February to July of 2001. During that time, the data show a rise in affected acres, a peek in affected area in March, and a decline into July. Because the data sample is very small, predictions about the trends are not accurate, but will suffice to extrapolate decline and recovery in monthly intervals based upon the data trends.

The best-case scenario that could occur is that the current restoration trend continues until the affected marsh is restored naturally. Marsh loss data from 2001 was used to extrapolate the time for total restoration under this hypothetical scenario. At a monthly recovery rate of 29 percent, with no new incidents of wide-scale marsh die back, total recovery could be achieved by June of 2004, and meaningful recovery could occur by 2003. Even with a full recovery the "brown marsh phenomenon" would have caused a total of $90.5 to $110.7 million dollars direct in economic damage in the project area.

If the status quo were maintained, essentially all of the marsh affected by the brown marsh phenomenon would remain impacted and no new loss attributable to the phenomenon would occur. Areas of marsh loss would have converted to open water or in some cases to non-vegetated mud flats. In this scenario, the annual economic damage would range from $72 to $88 million.

In a worst-case total loss scenario, the entire saline marsh system would be adversely impacted, resulting in an annual economic loss of $640 million to $1.3 billion.

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