Land Use and Socioeconomic Status and Trends in the Barataria-Terrebonne Estuarine System

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Publication #23
Barataria-Terrebonne National Estuary Program
1995

Citation:

McKenzie, L.S. III, M. W. Wascom, W. R. Keithly, R. E. Emmer, W. H. Hudnall, M. T. C. Johnson, F. Niami, and B. A. Touchet. 1995. *Land Use and Socioeconomic Status and Trends in the Barataria-Terrebonne Estuarine System.* BTNEP Publ. No. 23, Barataria-Terrebonne National Estuary Program, Thibodaux, Louisiana, 184 pp. plus Appendix.

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This project was partially funded by the United States Environmental Protection Agency and the Louisiana Department of Environmental Quality under Grant # CE-006660. The contents of this document do not necessarily represent the views of the United States Environmental Protection Agency nor the Louisiana Department of Environmental Quality nor do the contents of this document necessarily constitute the views or policy of the Barataria-Terrebonne National Estuary Program Management Conference. The information presented represents the scientific findings and interpretations of the authors and is intended to provide background information for Management Conference deliberations in drafting of official policy in the Comprehensive Conservation and Management Plan. The mention of trade names or commercial products does not in any way constitute an endorsement or recommendation for use.

This public document was published at a total cost of $. Three hundred copies of this public document were published in this first printing at a cost of $. The total cost of all printings of this document, including reprints, is $. This document was published by the Barataria-Terrebonne National Estuary Program, NSU Campus, P.O. Box 2663, Thibodaux, LA 70310, to provide the public with environmental information under the authority of La. R.S. 30:2011. This material was printed in

accordance with standards for printing by state agencies established pursuant to La. R.S. 43:31.

CONTENTS

APPENDIX

LIST OF FIGURES

LIST OF TABLES

Table **Page**

PREFACE

In 1990, the U.S. Environmental Protection Agency (EPA) and the State of Louisiana agreed to work as partners to establish the Barataria-Terrebonne National Estuary Program (BTNEP). The overall mission of the BTNEP is to work with a wide variety of citizens and interest groups to develop a comprehensive, long-term management plan to preserve and protect the fragile environmental resources of both the Barataria and Terrebonne basins. This novel partnership is based on the premise that true change will take place only if the basins' stakeholders determine for themselves the problems and the solutions. The BTNEP is composed of representatives of not only federal, state, and local government, but also landowners, industry, fishermen, farmers, citizens groups, and academic institutions. The BTNEP is administered by the Louisiana Department of Environmental Quality and governed by a series of committees, each with varied representation and expertise. The committees are collectively referred to as the Management Conference. The final product of the five-year planning process is a Comprehensive Conservation and Management Plan (CCMP) which incorporates specific actions to enhance the quality of life in the Barataria and Terrebonne basins.

One of the many steps taken during the five-year planning process was the development of a series of four reports, which document the current status and the past trends of particular resources within the basins. Members of the report preparation teams were selected by the Management Conference based on their expertise in a particular subject, and with an eye toward ensuring that each subject was given accurate, fair, and balanced treatment. The entire Management Conference and a team of designated reviewers reviewed each draft report and provided comments to the preparation teams at day-long interactive review meetings. At that time the Management Conference also agreed upon needed modifications to each report.

The final step in the BTNEP planning process is the finalization of the CCMP. The information presented in this report will be instrumental in the development of all the management recommendations made in the final CCMP, which is scheduled for submission to EPA in the summer of 1996.

For information about this or other reports or the CCMP, please contact the BTNEP Office.

Steve Mathies
Program Director

ACKNOWLEDGMENTS

The project team wishes to acknowledge the support and guidance provided by the Barataria-Terrebonne Estuary Program on this effort. Particular appreciation is extended to the Local Government Committee for developing the land use and socioeconomic component and for fostering its inclusion in the Status and Trends effort and to Mr. Stephen C. Smith, the BTNEP project coordinator, for his constructive review and guidance.

EXECUTIVE SUMMARY

The Barataria-Terrebonne estuarine system encompasses an area of approximately 6,500 mi², covering all or part of sixteen Louisiana parishes. The crooked-neck, squash-shaped basin begins on the Mississippi River near Morganza in Pointe Coupee Parish. Continuing south, the system is constrained geographically by the levee systems of the Mississippi and Atchafalaya rivers. Terrain varies from broad riverine flood plains in the north to coastal marshes in the south. The entire area is interlaced with natural levees that offer slightly elevated terrain attractive to cultural development.

The expanse of land within the system has been impacted by cultural and natural forces and by the combined effects of those forces. Sediment deposition, which is needed to replenish the system, has been severely impacted by human attempts to control nature through channelization and flood control levees. Activities developed by modern society have modified natural systems and accelerated natural erosion processes. Humans have impacted land use from the times of the earliest hunting and gathering activities to contemporary hydrocarbon extraction and transmission. The net results of these phenomena are land use change and, in some areas, land loss.

The amount of land suitable for development is limited. Most (78%) of the system is classified as wetlands or water. The amount of undeveloped land continues to decrease because of agricultural and urban expansion.

The estuarine system is home to 602,258 people. The population of the parishes that are part of the basin, either completely or partially, is 1,568,553. Of Louisiana's total population (4,219,973), 14% live within the study area, and 37% live in system parishes.

Approximately 75% of the population reside in urban areas. The entire Houma-Thibodaux metropolitan statistical area and the west bank portions of the Baton Rouge and New Orleans metropolitan statistical areas lie within the estuarine system.

Residents have, on the average, relatively low incomes. In 1989 the per capita income within the system was $9,824 as compared to $11,503 in its parishes and $11,207 in Louisiana as a whole.

The number of people in the work force is growing. Jobs are shifting among sectors with growth in the services and finance/insurance/real estate sectors and decline in the mining and contract construction sectors. The financial influence of economic sectors also is shifting. Of the nine economic sectors for which employee payrolls are reported, manufacturing ranked first in 1975 and 1990; mining dropped from second in 1975 to eighth in 1990; agricultural services ranked last in 1975 and 1990.

Earnings are shifting by employment sector. Manufacturing and transportation/utilities were the only two sectors where constant dollar payroll per employee increased from 1975 to 1990. In 1990 payroll per employee expressed as a percentage of payroll per employee for 1975 amounted to 59% for agricultural services, 62% for finance/insurance/real estate, 69% for retail trade, and 72% for mining. These percentages indicate a substantial drop in earnings on a per-employee basis for these sectors.

Human activity and land use change stimulated by economic influences have modified habitat and will continue to contribute to wetland loss and coastal erosion.

The future estuarine system will have more people and less land. The amount of land is decreasing because of coastal erosion and wetland loss. Natural processes of subsidence and rising sea level contribute to wetland loss and coastal erosion. Humans also contribute to land loss by building levees which deprive coastal wetlands of alluvial sediment and fresh water; by building canals in coastal wetlands that accelerate saltwater intrusion and physically convert wetlands to water; by clearing forested wetlands for development; and by dredging and depositing fill adjacent to canals, which disrupts the hydrological flow in wetlands.

The most recent projections indicate the population within basin parishes is expected to increase from 1,558,031 in 1990 to 1,696,190 by the year 2010, an increase of 183,178 people. Demands on land, water, and other natural resources will accompany the population increase.

The increased population is expected to cause the amount of urban land to increase by as much as 32,972 acres. This increase will likely be at the expense of agricultural land, which will encroach further on forest land.

The increased population will create demand for more consumables and services. The demand for potable water will increase. The increased population will generate more landfill waste and waste water. The presence of more people has the potential to impact the identified priority problems in the following ways:

•hydrologic modification—increased urban development leading to accelerated runoff; increased demand for forced drainage and flood protection levees; increased extraction of water for residential, commercial and industrial uses

•reduction in sediment availability—increased demand for flood-control structures that inhibit lateral discharge and sediment replenishment

•habitat loss/modification—increased pressure to encroach into sensitive habitat, especially wetlands

•changes in living resources—more people boating, fishing, hunting, and recreating outdoors

•eutrophication, pathogen contamination and toxic substances—increased waste water and runoff; increased generation of landfill waste.

Contending with these problems will not be easy, but solutions can be found. The people of the system can control their future. Quality land use and a viable socioeconomic environment are predicated on the actions of individuals, organizations, and governments. The mechanisms necessary to achieve a desired outcome are available within the existing societal and institutional framework; however, they must be put to prudent use.

The following research shows how land use in the Barataria-Terrebonne estuarine system has changed over the years as varying populations developed different economic orientations. It also shows how the economy has shifted dependency from one natural resource to another and how the recent economy has been changing from natural resource–dependent sectors to sectors where human resources assume paramount importance.

INTRODUCTION

Overview

The Barataria-Terrebonne estuarine system (BTES) encompasses an area of approximately 6,500 mi². The crooked-neck, squash-shaped system begins near Morganza in Pointe Coupee Parish (figure 1). Continuing south, it is constrained geographically by the levee systems of the Mississippi and Atchafalaya rivers until the Mississippi River turns sharply to the east in St. James Parish. From the Assumption–St. James Parish area south, the basin widens considerably until reaching the Gulf of Mexico along the coastal sections of Terrebonne, Lafourche, Jefferson, and Plaquemines parishes.

The system is physiographically diverse. Terrain varies from broad riverine flood plains in the north to coastal marshes in the south. The area is interlaced with natural levees that offer slightly elevated terrain attractive to cultural development.

Development and human impact are evident from settlements and from communication, utility and transportation networks. Although much of the study area is sparsely populated, the entire Houma-Thibodaux metropolitan statistical area (MSA) and portions of the Baton Rouge and New Orleans metropolitan statistical areas lie within the system.

The expanse of land has been impacted by cultural and natural forces. Sediment deposition, which is needed to replenish the system, has been severely impacted by human attempts to control nature through channelization. Activities cultured by modern society have modified natural systems and accelerated natural erosion processes. The earliest hunting and gathering activities impacted land use as do contemporary hydrocarbon extraction and transmission. The net result of these phenomena is land use change and, in some areas, land loss.

The estuarine system covers all or part of 16 Louisiana parishes. Four parishes (Assumption, Lafourche, Terrebonne, and West Baton Rouge) are located totally within the system. The west bank portion of eight parishes (Ascension, Iberville, Jefferson, Orleans, Plaquemines, St. Charles, St. James, and St. John) bisected by the Mississippi River are in the system.

Much of Pointe Coupee Parish, including the populated area in and around New Roads and Livonia, is in the estuarine system. Only the Morgan City area of St. Mary Parish located east of the Atchafalaya guide levee is in the system. Small and sparsely populated portions of the extreme southern part of St. Martin Parish and the extreme eastern part of Iberia Parish are in the system.

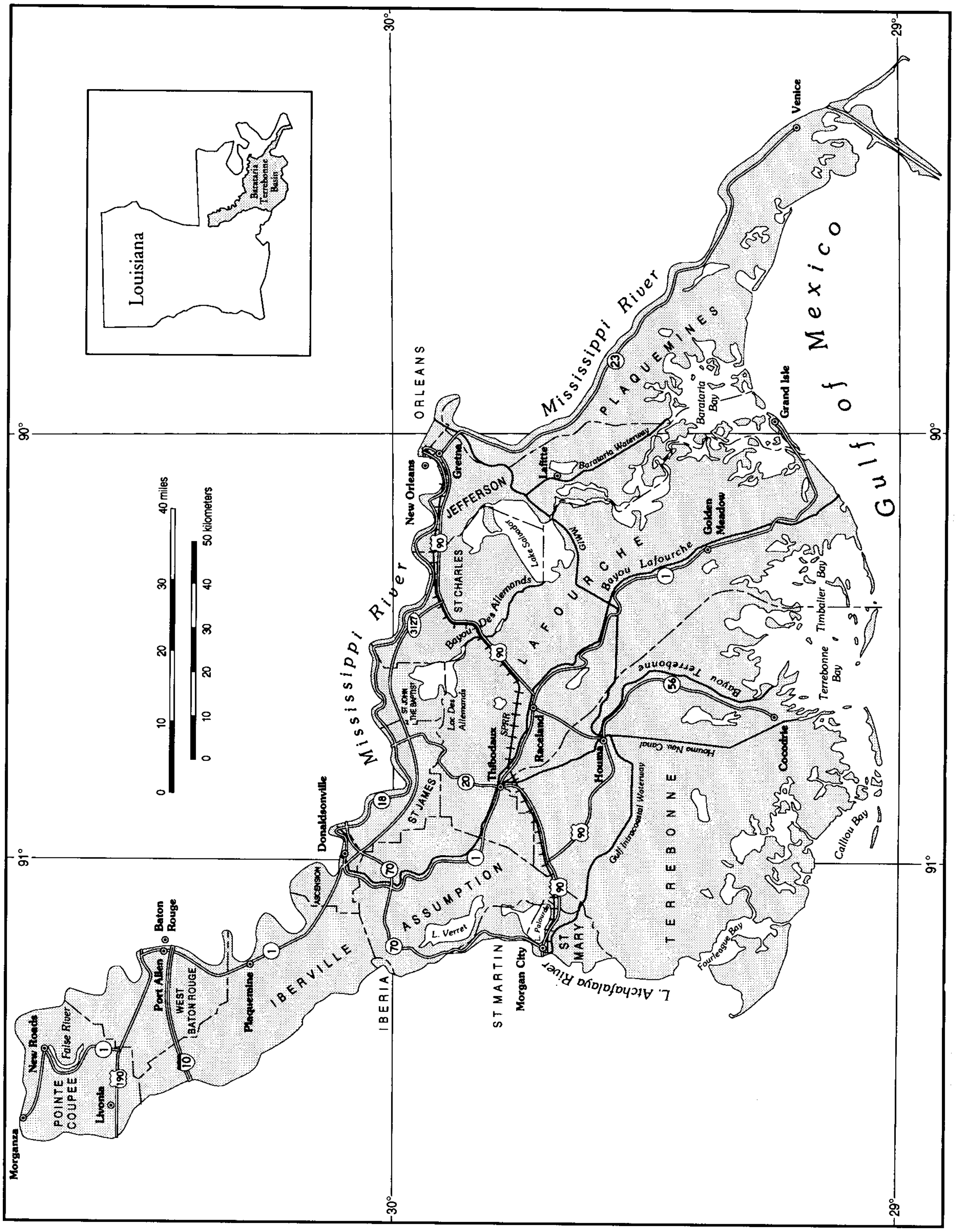


Figure 1. Map of the Barataria-Terrebonne estuarine system.

About one-in-seven Louisiana residents live in the Barataria-Terrebonne estuarine system. The system is home to 602,258 people (U.S. Bureau of the Census 1992a). The population of the parishes that are part of the basin, either partially or completely, is 1,568,553. Of Louisiana's total population (4,219,973), 14% live within the system, and 37% live in estuarine system parishes. Most people reside in urbanized parts of metropolitan areas.

Objectives

The status and trends of land use and socioeconomic characteristics of the Barataria-Terrebonne estuarine system constitute the subject of this report. The collective goals of the system status and trends series of four reports are to substantiate the problems affecting the estuary, to evaluate the cause of those problems, and to recommend management solutions. The status and trends reports provide the technical support and foundation for the characterization report. The characterization report is written for a nontechnical audience and will be distributed to the general public.

This report has been prepared to meet the following objectives: to characterize past socioeconomic and land use trends of the Barataria-Terrebonne estuarine system, to assess the current status of socioeconomics and land use, and to formulate future scenarios.

Presentation

Historical trends and current status presented in this document are based on existing data. These data have been analyzed to establish associations between socioeconomic activities and land use changes. Causal relationships were documented whenever possible.

Future scenarios have been formulated based on identified trends and likely future events. Management alternatives associated with control over likely future scenarios are presented. Throughout the effort, attention has been directed to the identification of relationships between socioeconomic and land use trends. The status and trends report of land use and socioeconomic characteristics within the Barataria-Terrebonne estuarine system documents present and historical scenarios as well as the direction and management of future scenarios.

Land use is categorized based on human activity on and civil ownership of the environment. Land cover (which is often used interchangeably with land use) refers to the natural or artificial components covering the earth's surface at a given location. While land cover is determined by physical surface characteristics, land use is reflective of human use of the land regardless of surface characteristics. Changes in land use are by definition primarily attributed to people. However, natural processes play a role in changing the suitability of land for human use.

The analyses of existing data have generated information on the present status of land use, cultural and natural factors that have impacted land use, land-user conflicts, and future land use scenarios.

Socioeconomic activity is culturally induced. A certain amount of the activity is associated with human exploitation of renewable and nonrenewable natural resources. Socioeconomic conditions and trends have been evaluated within the context of population (level of demand people are placing on the land) and industry (which natural resources and geographic advantages are being used in commerce and economic enterprises). Attention was given to identifying socioeconomic characteristics and the resulting impacts on indigenous cultures and on the land.

LAND USE STATUS AND TRENDS

Historical Land Use: 12,000 B.C.–1950

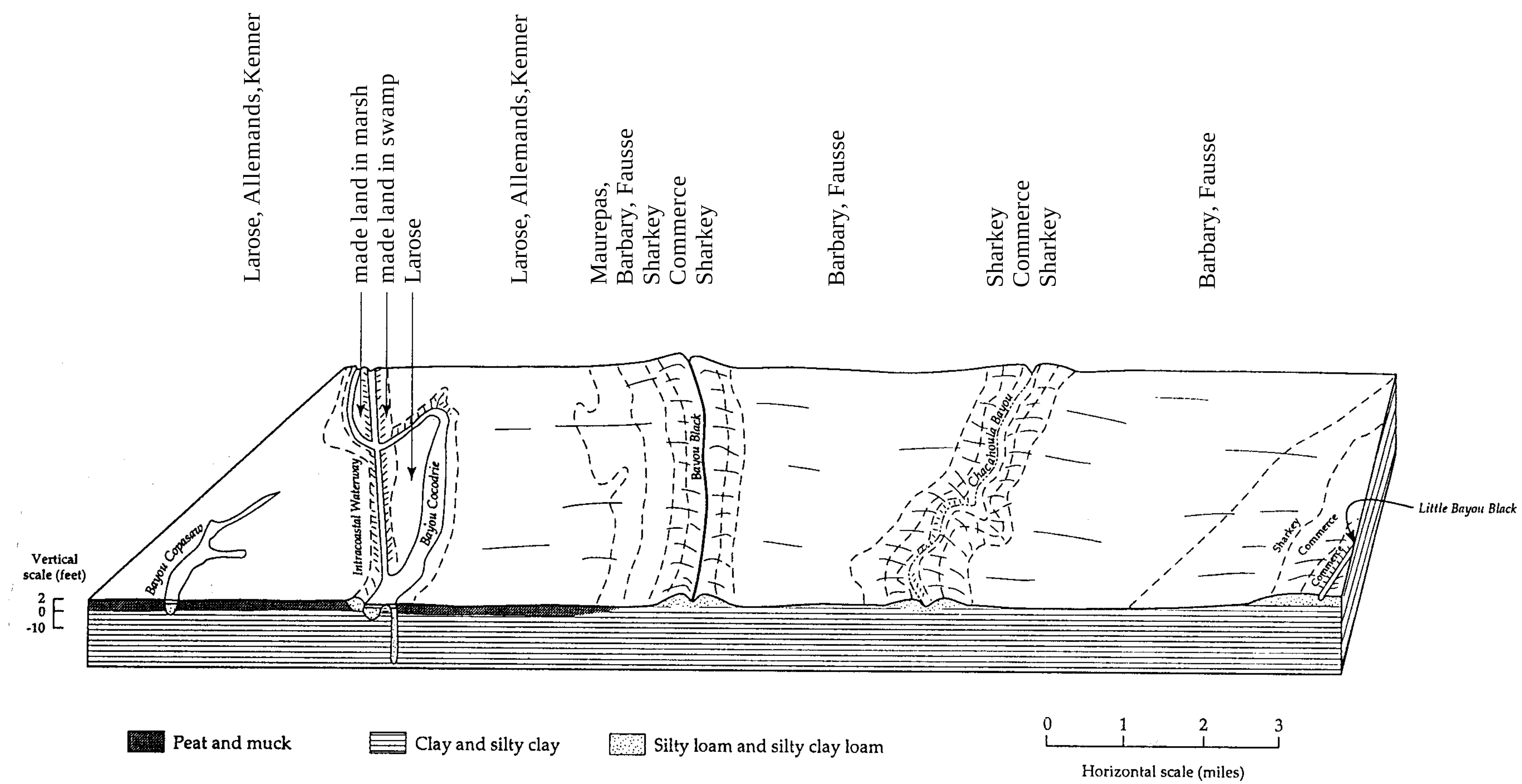
Landform and Surface Geology

Twenty-thousand years ago, when sea level was approximately 400 ft lower than today, the Louisiana shoreline was located far gulfward of its current position. From the period 17,000 to 4,000 years ago the Gulf of Mexico sea level rose to roughly its current height. The lower Mississippi River valley was an arm of the Gulf until alluvium filled the valley, and emergent deltas began to appear (Kolb and Van Lopik 1958). These Mississippi River deltas generally consisted of two major landforms: overbank or natural levee deposits consisting of loamy soil material, and the broad, interdistributary flats (swamps and marshes) consisting of clayey soil material.

The loamy deposits of the natural levees consisted of the Commerce or similar soils that have excellent potential for human habitation, agriculture, and animal husbandry (appendix A). The clayey deposits of the broad, interdistributary flats (swamps and marshes) composed of the Sharkey or similar soils are poorly drained and found on the lower parts of the natural levees and the back swamps in the interdistributary alluvial plains. Sharkey soil's potential for cropland and pastureland is good. If this clayey material does not dry and consolidate, however, the soil type is the Barbary series, which is nearly continuously flooded and consists of very poorly drained, semifluid, clayey soils on the low back swamps of the alluvial plain. These soils support swamp forests—primarily cypress, water tupelo, and red maple—and wildlife habitat.

The Louisiana Coast, especially the delta plain marsh, is a delicately balanced ecosystem. The soils of this system consist of mineral and organic material. The mineral soils consist of loamy Commerce soils and clayey Sharkey soils of the natural levees along distributary streams and back swamps, and the sandy Felicity soils and clayey Scatlake soils of the beaches or barrier islands and the salt sea rim (figure 2, appendix).

To survive subsidence along the bayous and wave action along the shore, these mineral soils require mineral nourishment. Without an active source of nourishment, these landforms will gradually give way to the sea. Nearly all of the Barataria and Terrebonne basins are sediment starved.



Source: Arville Touchet, 1995, adapted from Soil Survey Series No. 1 of Terrebonne Parish, 1956, U.S. Department of Agriculture and Louisiana Agricultural Experiment Station, Soil Conservation Service, Alexandria, Louisiana.

Figure 2. Diagram depicting the soil relationships in Terrebonne Parish from Minerva Plantation of Little Bayou Black southwest to Bayou Copasaw.
Source: Arville Touchet 1994.

The organic soils, which are the most fragile soils of the basin marsh, were developed by the accretion of plant material in a freshwater system as the deltas of the Mississippi River expanded into the Gulf. The subsiding soft mineral surface or mudflats between the distributary bayous was kept by the accretion of organic material preserved in an anaerobic condition in shallow water. Plants, such as maidencane and bulltongue, grew on top of the ever-subsiding older growth, thereby increasing the thickness of the organic layers. The thickness of this accretion of peat and muck depends on subsidence rate and time. It ranges from a few inches to >20 ft thick—the thicker the organic matter accretion, the more fragile the soil. The organic soils developed in this system are the Allemands and Kenner soil series (appendix).

Under natural conditions of delta deterioration when sediment is unavailable, brackish seawater may slowly encroach the Allemands and Kenner soil series land forms. A gradual change of vegetation occurs. The maidencane and bulltongue plants are slowly replaced by the marshhay cordgrass and Olney bulrush. The live plant-root mat that holds the organic soils intact is not destroyed.

When soil salinity surpasses 5 ppt. in salt content, the soils change from Allemands and Kenner soil series to Clovelly and Lafitte soil series (appendix). The Clovelly and Lafitte soil series landform, in turn, may be encroached by salt seawater. The brackish vegetation is slowly replaced by the more salt-tolerant smooth cordgrass and seashore salt grass. The live-root mat which holds the organic soils intact is not destroyed. When the salinity of the soil surpasses 8 ppt. in salt content, the soils change from Clovelly and Lafitte soil series to Bellpass and Timbalier soil series (appendix).

Whenever the sandy beaches and barrier islands' Felicity soil series and Scatlake soil series (salt sea rim) run out of mineral nourishment and are attacked and subsequently destroyed by storms, the Bellpass and Timbalier soil series are, in turn, attacked and destroyed by wave actions. The above action pushes the saline soils, Bellpass and Timbalier, farther inland, which in turn pushes the brackish soil, Clovelly and Lafitte, farther inland at the expense of the fresh Allemands and Kenner soil series.

When the marshlands have all disappeared, then the swamps and natural levees along old, inactive distributary streams will be subject directly to storms and wave actions. Whenever salt water intrudes a freshwater marsh system such as the Allemands and Kenner soil series areas, the freshwater vegetation is decimated. The root mat that holds the organic soil together is destroyed. The salt water disperses the organic matter and open water areas rapidly develop. Canals without saltwater locks that flow directly into the marsh interior are the principal cause of this very rapid, unnatural marsh loss.

If deltaic subsidence exceeds the rate of accumulation of mineral deposits, the land surface may somewhat maintain its elevation by the formation of organic plant remains. The peaty and mucky soils of these soft organic deposits are the Allemands and Kenner soil types of the freshwater marshlands, the Clovelly and Lafitte soils of the brackish marsh, and the Bellpass and Scatlake soils of the saltwater marshes (appendix).

Alluvial materials that are deposited in the longshore currents in the Gulf of Mexico off Louisiana become marine reworked material, lifted out of the shallow longshore currents by storm tides and deposited on top of the marsh along the coast. If the material is sandy, barrier islands consisting of Felicity soils are formed; if it is clayey, salt sea rims consisting of Scatlake soils are formed (appendix).

The first emergent delta within the system was the Maringouin delta, which formed in the area of the present-day communities of Livonia, Gross Tete, Maringouin, and Rosedale in Iberville Parish. The Maringouin delta is buried under more recent deposits. After the Maringouin delta matured, one of its major distributary channels extended and became the main river channel for the development of the Salé-Cypremort delta. This delta is also buried under more recent deposits (figure 3).

Just southwest of the present city of Plaquemine in Iberville Parish, the Salé-Cypremort channel crevassed to the southeast and became the main channel for the formation of the Cocodrie delta. Most of this delta has either been cut away or is buried by more recent deposits. A small part of this delta still exists in the Boutte area of St. Charles Parish.

After the Cocodrie delta was formed, the river shifted to the west side of the alluvial valley and formed the Teche delta (figure 3). Portions of the Teche delta still exist in the system, just east and south of Morgan City along Bayou L'Ours. When the Teche delta matured, the Mississippi shifted to the east side of the valley and produced a very large delta known as the St. Bernard delta. This delta is subsiding and rapidly disappearing. The Chandleur Islands are part of the St. Bernard delta. (figure 3).

A crevasse channel near the present-day town of Donaldsonville eventually captured the river and formed the Lafourche delta. This delta is entirely within the system. It is also rapidly subsiding, and its lands are disappearing at a rate that has increased from 18 mi^2/yr in 1978 to 22 mi^2/yr today (figure 3). Primary flow in the river shifted east forming the Plaquemine delta (figure 3). The present delta, the Balize delta, originated from a distributary channel out of the Plaquemine delta and is still forming (figure 3).

After the great Mississippi River Flood of 1927, Congress implemented the provisions of the Mississippi River and Tributaries Project (MR&T). The MR&T project was designed to prevent flooding along the Mississippi River. Construction of a control structure at Old River was authorized by Congress as part of the MR&T project in 1954. Without construction of the Old River Control Structure, it was estimated that the Mississippi would have again changed its course and that the Atchafalaya River would have become the new main channel of the Mississippi River between 1965 and 1975. While the structures have prevented this course change, the 70–30 flow distribution maintained between the rivers by the Old River structures has resulted in the formation of a new delta at the mouth of the Atchafalaya River (Wascom and Wallace 1994).

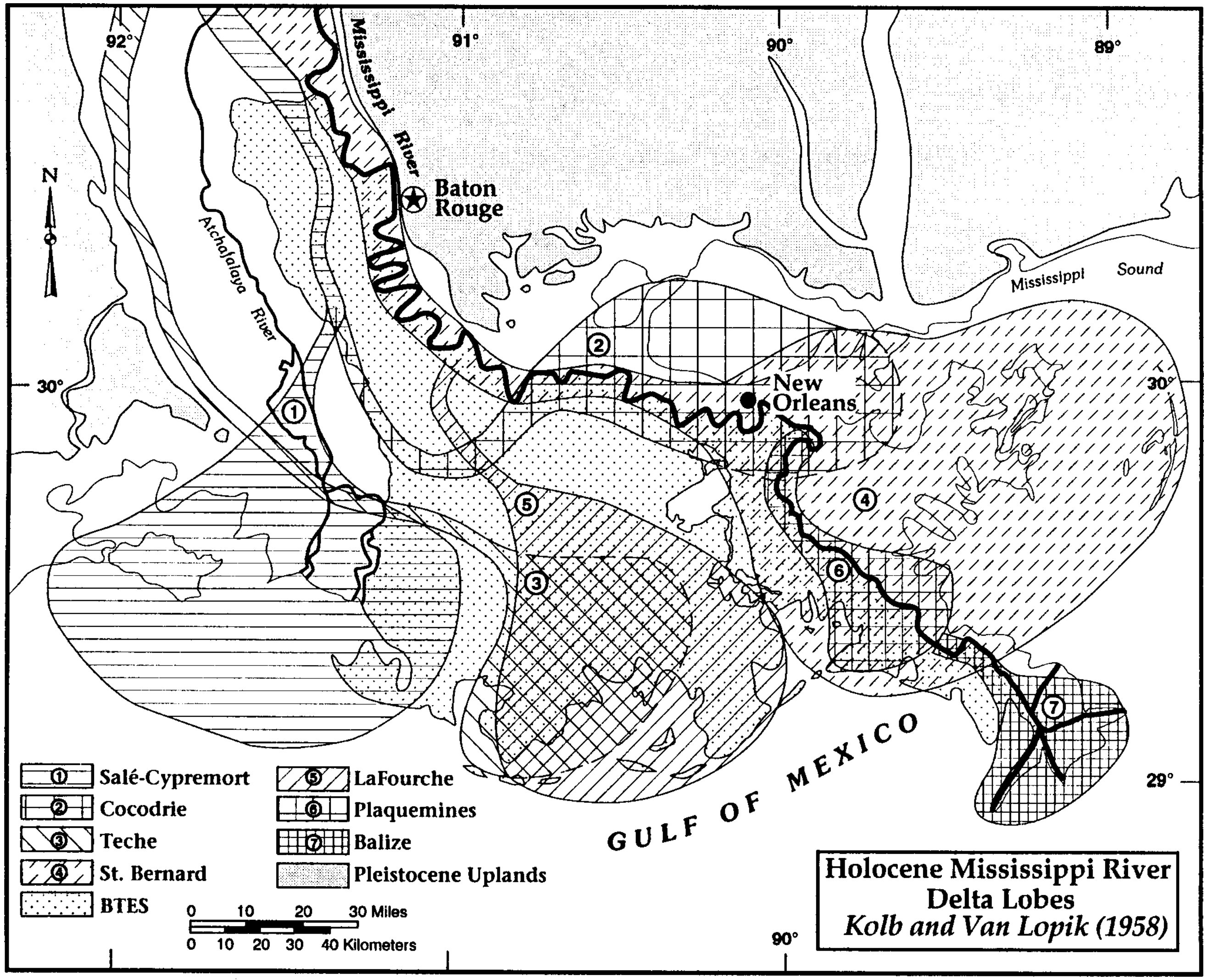


Figure 3. The deltaic lobes responsible for the creation of the deltaic plain.
Source: Kolb and Van Lopik 1958.

First Occupation: Land and Human

These various deltas emerged and pushed out to sea, offering a new and dynamic resource with very rich soils. As soon as the vegetation and wildlife took hold of these new landmasses, it became attractive for humans because of the abundance of food, proximity to freshwater sources, and ready access to a transportation network.

A diversive vegetative cover developed on these new deltas and created transition zones ranging from bottomland hardwoods to swamp, marshes, lakes, and bays. Wildlife and plants were plentiful and diverse over very short distances. They ranged from deer, bear, turkey, rabbit, squirrel, raccoon, and opossum to muskrat, otter, turtle, and bullfrogs. The rivers, bayous, bays, wetlands, and ridges produced clams, oysters, catfish, drum, gar, and bowfin as well as roots and berries. The area is a natural component of the Mississippi River flyway for migratory birds, many of which spend winter in the area (Kniffen and Hilliard 1988).

Native Americans probably first inhabited portions of Louisiana 10,000–12,000 years ago (Kniffen et al. 1987). Kniffen and Hilliard (1988) described how these first inhabitants found Louisiana: “Sea level was lower, broad grasslands extended towards the Gulf of Mexico and to Lake Ponchartrain, and mammoths, ground sloths, and other mammals now extinct were abundant in Louisiana.”

The oldest Native American sites in Louisiana were associated with streams draining the terraces and on Avery Island. The early Indians likely lived in the flood plains and possibly along the shore of the Gulf. For example, shell middens (piles of discarded shells) are common in lower St. Mary Parish south of Morgan City. They indicate that coastal shellfish were a prominent element of the diet of Native Americans in that region. At the time that Europeans began to inhabit Louisiana (about 1700), Native Americans were still living in the flood plains, but the coastal population was less than it had been 500 or 1,000 years earlier (Kniffen et al. 1987).

The first Native Americans to occupy those new areas subsisted from hunting, fishing, and gathering. Their main protein sources were deer (supplemented by other upland wildlife), shellfish and fisheries, and waterfowl during the winter months. Starch sources included tuber-producing genera such as *Smilax* (greenbriar), *Scirpus* (bulrush), and *Sagittaria* (arrowhead). Because reliance for food was based on hunting, fishing, and gathering, very little agriculture was utilized.

The abundance of food found along the natural levees and back swamps of the major streams and the use of the ready-made, maintenance-free system of waterways for transportation meant that native populations were strongly concentrated along the waterways (Kniffen and Hilliard 1988).

The natural levee ridges also offered the highest and best-drained ground for building homes and fields. Consequently, Native American settlement patterns were linear along the larger, active distributary streams, with settlement centers at confluences of streams because two or more waterways for travel were available there. To provide greater utilization of the available natural resources, the population was initially widely scattered.

As the landforms and soil provinces became more stable, populations began coalescing into larger groups. Centers of populations were positioned at points of maximum transitional area between adjacent ecological regions (e.g., areas of water-land interface) with an emphasis on the use of the available lacustrine environment and water corridors for transportation.

With the development of larger population centers about 2,000 years ago came a need for intensive agriculture in surrounding regions. During the period immediately before European colonies, Native Americans relied on maize (corn), beans, and squash, supplemented by hunting, fishing, and gathering. Kniffen and Hilliard (1988) describe the role that fire played in Louisiana Native American slash-and-burn agriculture:

> They girdled trees to make them die, lose their leaves, and let the sun get to the ground. Small brush was cut, piled, and burned, thus creating a clearing for planting and incidentally adding potash fertilizer from the ashes to the soil. Fires were set to produce better grazing and so encourage the presence of game. Fires were also set to clear the ground under nut trees so that the crop could be more easily gathered...Clearing the forest for agriculture and repeated burning created grassy openings, some of them now referred to as Indian old fields. The openings encouraged the greater growth of sunloving plants, or heliophytes. In heavily forested areas burning tended to destroy hardwood trees.

At the time the Europeans (initially the French) came to live in Louisiana (about 1700), there were perhaps 15,000 Native Americans living here. Three dominant linguistic families lived in Louisiana at that time: Muskhogeans, Tunican, and Caddoan. The three major tribal groups located in the vicinity of the Barataria-Terrebonne estuarine system were the Houmas (Muskhogean), near present-day Angola; the Bayougoula (Muskhogean), near the present community of Bayou Goula in Iberville Parish community; and the Chitamacha (Tunican), located at the mouth of Bayou Plaquemine, on the Mississippi River, and on Bayou Lafourche (named Lafourche de Chetimeches by the French) (Kniffen et al. 1987, Kniffen and Hilliard 1988). These tribes initially cooperated with and assisted the French explorers and settlers of French Louisiana; however, battles over living space and hunting grounds, the practice of Native Americans being sold into slavery by the French, the ravages wrought on Native Americans by diseases brought by Europeans, and wars and other intertribal conflicts eventually caused the relocation of these tribes. Nearly all of the Chitamacha villages on Bayou Plaquemine, Bayou Lafourche, and the Mississippi River vanished. Their ancestors now live on a small reservation near Charenton. The Bayougoulas were later assimilated into the Houmas. Eventually, the Houmas relocated to the coastal marshlands, where they remain today (Terrebonne, Lafourche, and Jefferson parishes). As Kniffen et al. (1987) noted:

> Harassed tribes such as the Houma found refuge literally at land's end, occupying the attenuated natural levees that extended toward the Gulf of Mexico. Places of concentration included Barataria, Bayou du Lac, Grand Caillou and Isle Jean Charles. The settlements in these places were the antecedents of the line villages of later French population.

Many present-day communities in the system are located on the site of former Native American villages, e.g., Houma, Grande Isle, Labadieville, Livonia, and Brusly.

As of 1990 there were 10,354 Native Americans in the region (U.S. Bureau of the Census 1992a). Aside from their descendants and the culture that they maintain, the Native Americans have left one very significant Louisiana imprint: place names, such as Chacahoula, Plaquemine(s), Cabahannocey, Chetimeches, Atchafalaya (River), Fordoche, (Lake) Cataouache, Choupique, and Bayou (Bayou Choctaw, Bayou Latenache, etc.) (Parkerson 1969, Kniffen and Hilliard 1988).

European Settlement Imprints

The first European explorers and settlers in south Louisiana learned much from the native Americans and their understanding of the landscape. New animals and plants, such as maize and persimmons ("plaquemines" from the Native American "piakimin") were incorporated into the European diet. Filé—dried and ground sassafras leaves—became a staple in what would become the unique Louisiana cuisine known around the world. The Europeans used the same Native American water highways and trails along levee ridges, and their towns grew on the sites of or near Native American villages located on the natural levees. Consequently, there was continuity of settlement patterns from the Native Americans to the Europeans.

Two French Canadians, Iberville and Bienville, were responsible for establishing the permanent settlement of the French colony of Louisiana. In 1718 Bienville chose a location on the lower Mississippi River for a new city, New Orleans. It had a relatively high natural levee and was the shortest distance from Lake Ponchartrain at the location of a Native American portage that ran from the River to Bayou St. John, and thence to the lake. It would shortly become the capital of the French colony (Davis 1960, Kniffen and Hilliard 1988). The early history of draining, levying, and establishing New Orleans and its vicinity was indicative of the process of future development in south Louisiana, especially in the system, because it foreshadows the manner in which the Europeans would convert swamp and marshland to human uses, including habitation and transportation.

Getting the site cleared and a town established proved to be no easy task, and the work progressed slowly because the natural levee at New Orleans is narrow and the back swamp was relatively close to the river. Finally, in 1720 an assistant engineer arrived from John Law's Company of the Indies, which held a proprietary grant from the French king to operate the Louisiana colony. Under the direction of engineer Adrien de Pauger, the town gradually began to take shape. Drainage ditches and canals were dug, and a low levee fronting the town was built (Davis 1971).

Initially, the Company of the Indies forced French criminals and persons of bad character to come to Louisiana to colonize. They were in Louisiana against their will and had no desire to build a colony. A subsequent attempt to attract wealthy Frenchmen to the colony also failed. Finally, in an attempt to attract families to settle the Louisiana colony from other nationalities, the Company of the Indies flooded sections of Germany, the Low Countries, and Switzerland with pamphlets and handbills describing the "wonderful land of Louisiana." The Company promised to pay the expenses of families who came and to give them "thirty arpents of land, horses and oxen for the cultivation of fields, pigs, sheep, and chickens, furniture and kitchen utensils, and food supplies for the first harvest." (Davis 1971)

From 1719 to 1721 roughly 250 German colonists recruited by the Company of the Indies were settled on the west bank of the Mississippi River about 30 miles north of New Orleans. They were later joined by Germans brought over by the French and settled in Arkansas who, after receiving little assistance, returned to New Orleans, demanding passage to return to Europe. The French authorities convinced them to settle at the German coast. After a hurricane in 1722 destroyed two of their settlements, some of the German colonists migrated to the east bank. This area, now comprising St. Charles and St. John parishes, became known by the French as Côte des Allemands, the "German Coast" (Le Conte 1967, Read 1963, Kondert 1985). Many German immigrants followed.

In 1722 the Company of the Indies went bankrupt, and the Louisiana colony was in a state of disarray because of disruption in shipments of goods and food from France. The hard-working residents of the German Coast came to the colony's rescue in order to take advantage of the opportunity to own their own farms and succeed in this new land. They became industrious farmers and within ten years were supplying their coveted surpluses of vegetables, herbs, butter, eggs, and poultry to New Orleans (Kondert 1985). The Germans are credited with saving the Louisiana colony by adjusting to their new landscape and converting what had been wilderness to productive farm land.

The Germans also left their imprint on place names such as Lac des Allemands and Bayou des Allemands and on names of communities such as Kraemer, Montz, Des Allemands, Hahnville, and Luling. The German surnames have often become gallacized. For example, "Zweig" (German for twig) became "La Branche," Trischl became Triche, Himmel became Hymel, Foltz became Folse, and Dubs became Toups, (Deiler 1909).

In the early 1760s, while Louisiana was still under French rule, exiled residents of the former French Acadia (present-day Nova Scotia), began arriving in Louisiana. These Acadians initially settled in the area of the Mississippi River just above the German Coast. From this Acadian Coast (the current parishes of Ascension and St. James), some settled on the broad natural levees of Bayou Lafourche and at the settlement of Pointe Coupeé. The Acadians cleared some of the clayey land between the natural levee and the swamps or marshes as pasture land for their cattle.

With European colonization, the concept of defined land ownership became important. The French brought a concept of land division that assured an equitable partitioning of land. A narrow but deep partitioning based on the arpent (192 ft) assured each landowner five to six arpents of frontage on the higher and drier lands most suitable for cultivation. These lots extended back 40 or more arpents onto the heavy clay soils of the poorly drained swamp. Linear communities developed on the "frontlands" bordering the rivers and bayous. This division is best illustrated by Bayou Lafourche, approximately 85 mi of continuous development from Donaldsonville to Golden Meadow.

When the Spaniards took control of Louisiana from the French in the 1760s, they generally confirmed French practices in granting land to new settlers. The French and Spanish required a grantee of land

> to clear his property back for a distance of two arpents, build and maintain levees and construct a road forty feet wide next to the levee. He then had to dig parallel drainage ditches the length of his property from levee to back swamp, and he had to build culverts over the ditches where they crossed the road.
>
> This system of running property lines at right angles to the river, from front lands to back swamp, worked out very well for those grants located on the outside, or convex side, of a meander, for here the lines kept getting farther and farther apart away from the river. The owner had an increasing width of land, with more to cultivate and more back swamp for timber. But what of the grantee who got his land on the inside, or concave side, of the meander? His property lines quickly converged so that his cultivated acreage was much reduced, and he might have too little or too much back swamp. Few people wished to have property on the inside of meanders. The Spanish authorities wanted the land continuously occupied so that someone would be responsible for building and maintaining levees and roads. To bring this about they granted twice as much frontage, or twelve arpents, on the points that occupied the inside of meanders. If this was not attractive enough, the land was sometimes granted outright to neighboring owners (Kniffen and Hilliard 1988, figure 4).

Trees were cleared for fields on the "frontland" and on the "backland," the area between the "frontland" and the swamp. Initially agriculture meant small farms growing produce needed by an expanding urban population. Eventually, specialization began with the first major crops of indigo and rice. Indigo remained an important commodity until 1794. In 1750 sugarcane arrived in Louisiana with Jesuits from Saint Domingue (Haiti), but it did not become the dominant crop until in 1794

> the indigo crop, the staple of extreme South Louisiana at the time, was blighted by damp weather and/or by a worm that devastated the crop. The planters faced ruin, and in desperation one of them, Etienne de Boré, decided to risk his fortune in the manufacture of sugar, although this crop had failed in all previous trials and Boré's father-in-law, Jean-Baptiste Destréhan, had suffered disastrous reverses in his attempt to manufacture sugar some time before. Boré is said to have purchased a supply of cane from two Spaniards, Méndez and Solís, who had been manufacturing rum at Terre-aux-Boeufs, and with the advice and expert help of a sugar maker named Antoine Morin from Santo Domingo, he succeeded in making sugar granulate (Center for Louisiana Studies 1980).

This development encouraged consolidation of smaller farms into plantations. It was not, however, until the British blockaded the port of New Orleans during the War of 1812, cutting off supplies of sugar from the Caribbean, that Louisiana sugar production increased dramatically (Lytle 1959).

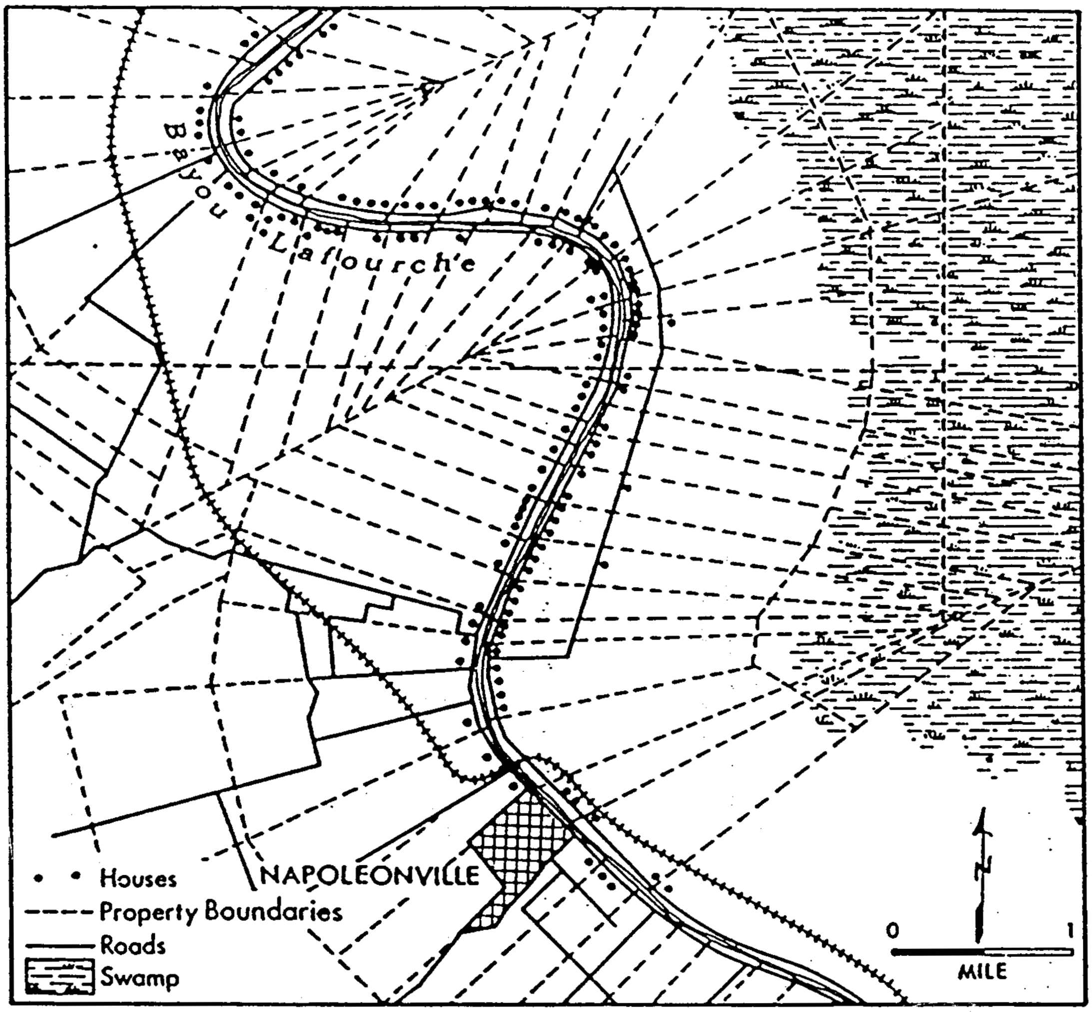


Figure 4. Land-holding settlement patterns.
Landholding boundaries (dashed lines) and houses (black dotes) indicate the manner in which settlers arranged their holdings. Note how landholdings taper from front to back on the inside and outside of bends in the bayou.
Source: Kniffen and Hilliard, 1988.

After establishing themselves as small farmers, some of the Acadians developed small plantations to grow sugarcane. In many cases, larger plantations grew after 1803 when Anglo-Americans poured into the Mississippi River and Bayou Lafourche regions and purchased several smaller parcels from Acadian "petit habitants" (small farmers) to form plantations. The Acadians then moved into the swamps and onto the narrower ridges further west and south.

A sugarcane plantation in Louisiana required a good drainage system, which all owners of sugarcane developed. Because most of the cane was grown on the natural levees along waterways, drainage was imperative for a good yield, and ditches were dug to drain into the swamp and/or into a drainage ditch at the "back" of the plantation. At present, there are numerous levee districts established in the system that now have grown to protect urban and suburban land uses.

Because sugar and other goods needed to be moved to market in New Orleans and the major streams of the Mississippi River delta plain ran north-south, a series of private east-west toll canals were created to enable the transport of crops and goods back and forth to market. For example, the Barataria and Lafourche Canal Company's canal (Company Canal) allowed for water transport between New Orleans and Thibodaux. A later canal extended navigation from Thibodaux to Morgan City. Two other examples were the Attakapas Canal and Harvey Canal (Becnel 1989). Segments of the Company Canal and Harvey Canal became part of the Gulf Intracoastal Waterway, completed in 1934. Over the years, many drainage canals and trainasses dug by trappers in the system widened through erosion to become navigation or drainage channels (Davis 1972).

Bayou Plaquemine served as an access highway to the Atchafalaya basin and the lands to the west of it (Comeaux 1972, Brasseaux 1987). A navigation lock was constructed at Bayou Plaquemine in 1909 and closed in 1961 when the alternate route of the Gulf Intracoastal Waterway was constructed.

Louisiana Purchase–1900

After Louisiana was acquired by the United States in 1803, a great population influx from other areas of the country continued throughout the nineteenth century. Over the years, as demand for farm land increased and available cleared levees became scarce, there developed a movement to open up the swamps and marshes to development. Most of these "swamp and overflowed lands" in Louisiana were owned by the U.S. government.

By virtue of the Swamp and Overflowed Lands Act in 1849 and 1850, the federal government conveyed 9.5 million acres of land to Louisiana. These lands were transferred on the condition that funds from the sale of this land be used to build the levees and drainage necessary for the state's economic development. In 1853 Louisiana created three major levee and drainage districts governed by a board of commissioners who hired engineers to determine the locality, extent, and dimensions of the levees and drains necessary to protect and reclaim swamp land for the state. The commissioners of each district formed the Louisiana Board of Swamp Land Examiners (Harrison 1961). Many of these district boards remain active.

Railroads were extended from New Orleans to the west, including a line to Brashear City (Morgan City) in 1857. This construction, coupled with the availability of cheap marsh land made available by the Swamp and Overflowed Lands Act, created a number of marsh reclamation and development schemes in coastal Louisiana for diking, draining, and reclaiming land for agriculture and pasturage. A leading supporter of these efforts was Edward Wisner. Through his Louisiana Meadows Company and affiliated companies, Wisner at one time owned 1,500,000 acres of coastal marsh, purchased at 12½ cents an acre. His and other such projects involved levying an area of marsh and draining the levied area with forced drainage (using pumps). While some of these "marsh developments" succeeded in staying dry and are evident in the system today, most failed, including Delta Farms, Clovelly Farms, and Avoca Island in the system (Davis 1972).

The failed Avoca Island reclamation project was located south of Morgan City. The work began in 1890, and by 1914 there were three major pumping stations with 42 miles of canal and a levee system that surrounded the entire island. All of this came to an end with the Mississippi River flood of 1927. The levees were broken in several places, inundating much of the island's interior. The entire venture went bankrupt in 1928. The Whitney Bank of New Orleans now owns Avoca Island.

Louisiana's coastal marshes and barrier islands were initially populated by various privateers and pirates in the 1700s and early 1800s. They found the unique configuration of the Louisiana coastline to be good for eluding capture. Three examples of human adaptation to the lower landscape of the system and susceptibility to the forces of nature in the nineteenth century were the shrimp-drying platform communities of Barataria Bay, the resort complex at Last Island, and the community of Cheniere Caminada.

In the 1800s, a series of more than 75 shrimp-drying platform villages such as Manilla Village, Bassa Bassa, and Fiji's Island were established in Barataria Bay by Filipinos and a variety of other immigrant groups. The great hurricane of 1893 destroyed these villages and their platforms. Manilla Village returned to business but closed for good in 1965 after being destroyed by Hurricane Betsy.

Last Island was a Louisiana barrier recreational resort in the 1840–1850s. Affluent vacationers would arrive by steamboat from Houma and New Orleans to stay at either the Ocean House or Capt. Muggah's Hotel. The resort days of Last Island ended with the hurricane of 1856, which wreaked havoc upon the Island and left 150 dead and the novel hotels destroyed. The legend of Last Island was immortalized in Lafcadio Hearn's novella *Chita*. No attempt was made to rebuild the resort, and Last Island became known as Isles Dernieres (Sothern 1990).

Cheniere Caminada was a barrier island adjacent to Grande Isle and originally known as the "Island of Chetimachas." The island had 1,470 inhabitants when the hurricane of 1893 destroyed the thriving community. The settlement was abandoned, and the surviving residents moved to higher ground in Leeville and Golden Meadow (Davis 1990).

1900–World War II

Because of the great demand for lumber from a burgeoning U.S. population in the late 1800s, and because timber supplies in the northern United States were nearly exhausted, lumber companies began buying up timber properties in the South. One of the most desired species was cypress, so the cypress swamps of the system were a major target of these companies. The cypress logging industry grew rapidly with the development of two logging technologies in the late 1880s: the "pull boat" and the "over head skidder" (Mancel 1972, Norgress 1935).

In Louisiana, the heyday of the cypress logging industry was 1890–1925 (Mancel 1972, Norgress 1935), although the industry continued a few years beyond 1925. Aside from decimating the first growth cypress of Louisiana, the cypress logging industry left numerous logging canals, some of which are today used by oil companies, sportsmen, and trappers and as drainage canals by local governments (Davis 1972).

After the great Mississippi River flood of 1927, Congress passed the Mississippi River and Tributaries Project, which required larger, more secure levees and a series of floodways. In Louisiana, levees along the Mississippi River were designed to better confine flood waters, and the Atchafalaya Floodway System and its attendant guide levees were established. Another result was that sediment replenishment from annual overflows in the Mississippi River would cease.

This levee building—along with improved drainage and pumpoff capabilities and the advent of tractor power in 1939—expanded sugarcane culture to the clayey Sharkey soil series landforms of the back swamps and to the mucky and peaty landforms of freshwater marshes and its fringe (appendix).

World War II–1950

Although a major oil field had been found in 1901 beneath the marsh at the Spindeltop field near Beaumont, Texas, the logistics of exploring the marshes in Louisiana at that time were too complicated for most companies. Oil and gas exploration and development continued in other areas of Louisiana, and the Standard Oil of New Jersey oil refinery at Baton Rouge was constructed in 1909 (Gramling and Brabant 1984).

In the late 1920s the Texas Company (Texaco) began to lease large areas of the coastal wetlands from the state of Louisiana and the Louisiana Land and Exploration Company. To explore these leases at an economical price per well, G. I. McBride of Texaco submitted plans in 1932 for a drilling barge that could be floated to the location and sunk so that it rested firmly on the bottom. After drilling, the barge could be raised, then quickly and economically moved to a new location. No platform would be necessary because everything needed would be on the barge or could be supplied by boat when necessary. A routine patent search was conducted, and it was discovered that Louis Giliasso had secured a patent on what later came to be known as a submersible drilling barge on August 21,1928. After designing the drill barge, Giliasso had attempted unsuccessfully to market his design to various companies (Gramling and Brabant 1984, Davis and Place 1983).

Texaco came to an agreement over patent rights with Giliasso and decided to risk building a rig that consisted of two barges fastened together. Just in case it did not prove feasible, the design allowed the two units to be easily converted into ordinary barges so that the investment would not be totally lost. A contract was signed, and the rig was built at Leesdale, Pennsylvania, and floated to Louisiana. A third barge carried a steam power plant that could be connected to the drill barges. On November 7, 1933, the "Giliasso" as the rig was named, spudded the State-Lake Pelto #10. The rig had been designed to drill 6,000 ft deep in water up to 15 ft deep. This rig proved an immediate success because on completion of drilling it was ready to be moved to a new location in one or two days. Once the new site was secured, drilling could commence again in several days on another site. Before the development of submersible drilling rigs, approximately 17 days were needed to set up a well and a similiar time to get the rig disassembled and transported to a new site. Almost immediately the news of this success spread, and the big oil and gas exploration rush into the Louisiana wetlands was underway (Gramling and Brabant 1984, Davis and Place 1983).

One of the major land use impacts from the development of oil and gas in Louisiana's coastal wetlands has been the extraordinary damage caused by the construction of oil and gas canals. While coastal Louisiana was very familiar with canals—e.g, trainasses of trappers, drainage canals, and navigation canals—the proliferation of oil and gas canals in coastal Louisiana wetlands since 1933 has been dramatic. More than the actual acreage excavated for these various types of canals is involved: when they erode they become significantly larger (Turner and Cahoon 1988). However, the advent of the Louisiana coastal use-permitting program in 1981 has significantly reduced the average length of oil and gas canals permitted since that time (figure 5). Nevertheless, it has been estimated as of 1990 that 6,953 mi (linear) of human-made canals crossed the Louisiana coastal plain and that 20 ft of spoil bank existed for every acre of the coastal plain (R. E. Turner 1995).

Sulphur mining in the system began in 1933 and has continued to be an important industry. To alleviate transportation problems associated with development of its Grande Ecaille mine, Freeport Sulphur created the town of Port Sulphur as a base. While sulphur mining in the system has heavily declined, sulphur from the new Main Pass complex will be barged to Port Sulphur for shipment (Davis and Detro 1992, *Times-Picayune* 1990).

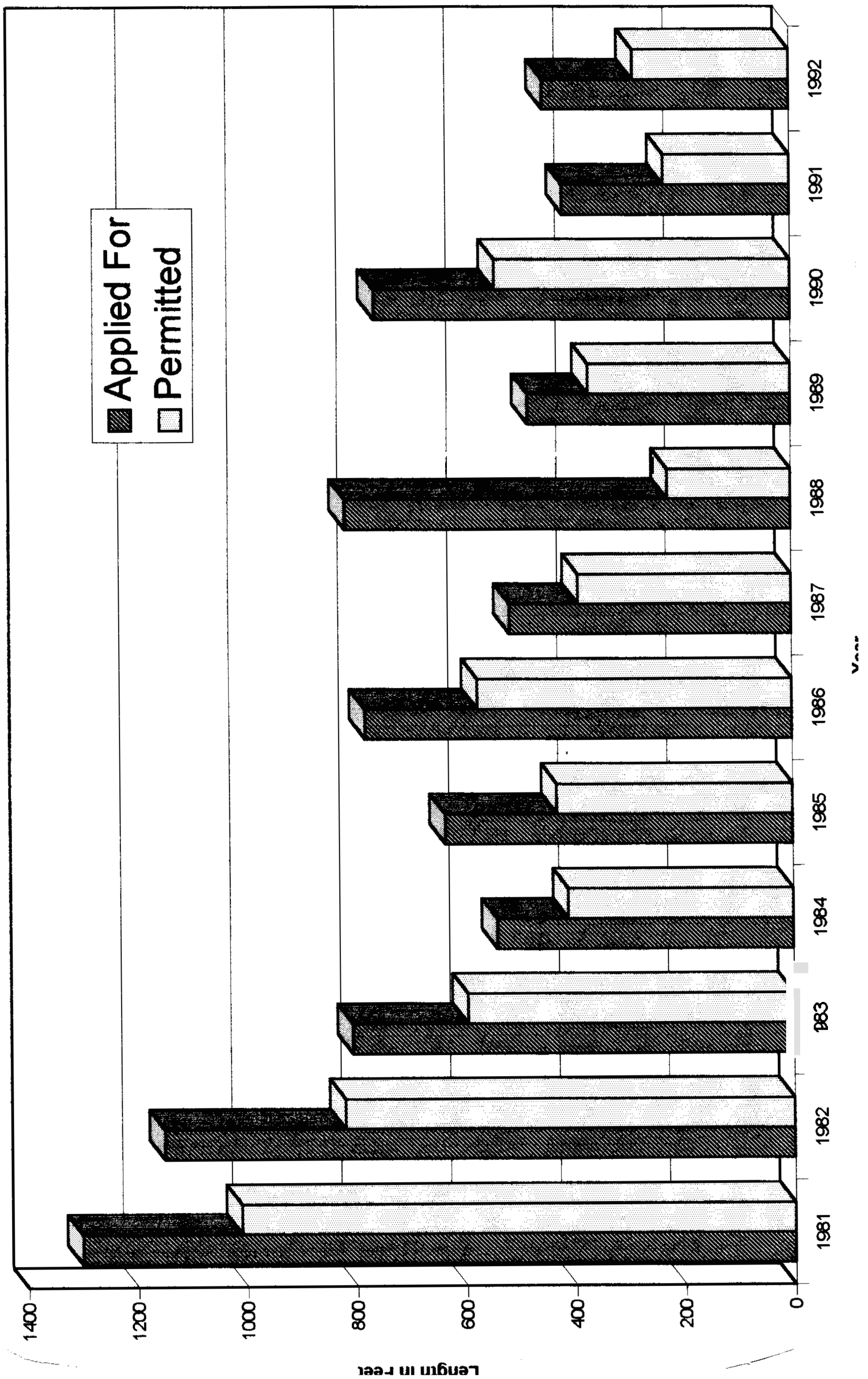


Figure 5. Oil and gas canal average lengths: 1981–1992. Source: Morgan, 1994.

Current Imprints: 1950–Present

Overview of Current Land Use

Interpretations prepared by state and federal agencies characterize land use in the system and for the parishes wholly or partially within the system. The statistics vary because of differences in methods used to estimate land use, in classifications used to categorize land use, and in definitions of project area boundaries. These differences place limitations on making comparisons across sources.

The latest available land use assessment sets the size of the Barataria-Terrebonne estuarine system, including coastal bays and coastal waters of the territorial sea, at 4,158,939 acres or 6,498 mi² (Louisiana Department of Environmental Quality 1993a). Over three-quarters of the system's area is classified as either water or wetlands (table 1 and figure 6). Agriculture accounts for the largest proportion of nonwetland use in the basins, followed by forest land and then urban and built-up land (figure 7).

Table 1. Land use in Barataria and Terrebonne basins.

Classification	Acres	Percent of Total
Urban	111,818	2.69
Extractive	8,673	0.21
Agricultural	501,951	12.07
Forest land	287,314	6.91
Water	1,186,224	28.52
Wetland	2,054,786	49.41
Barren land	8,173	0.20
Total	4,158,939	100.00

Source: Louisiana Department of Environmental Quality 1993a.

The land, the coastal waters, and the wetlands support extensive renewable resources, but traditional human development is by necessity concentrated in a relatively small area. Because over three-quarters of the basin is classified as open water or wetlands, only about 22% of the area is considered conducive to traditional cultural development for urban and agriculture uses based on soil capability to support development. The area suitable for development conforms with the areas characterized by Commerce and Sharkey soils (Touchet 1994, table 2).

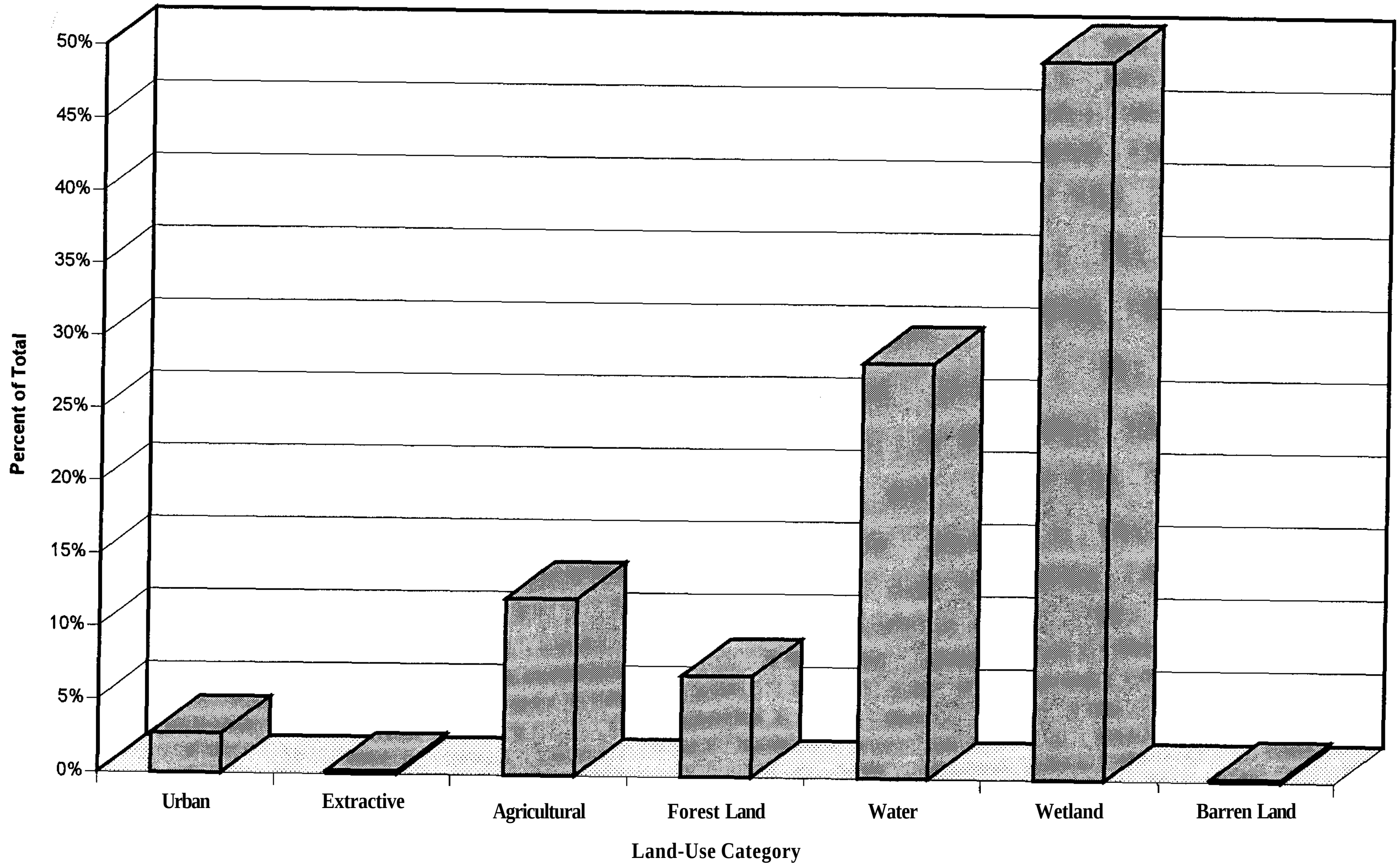


Figure 6. Land use in the Barataria and Terrebonne basins.
Source: Louisiana Department of Environmental Quality 1993a.

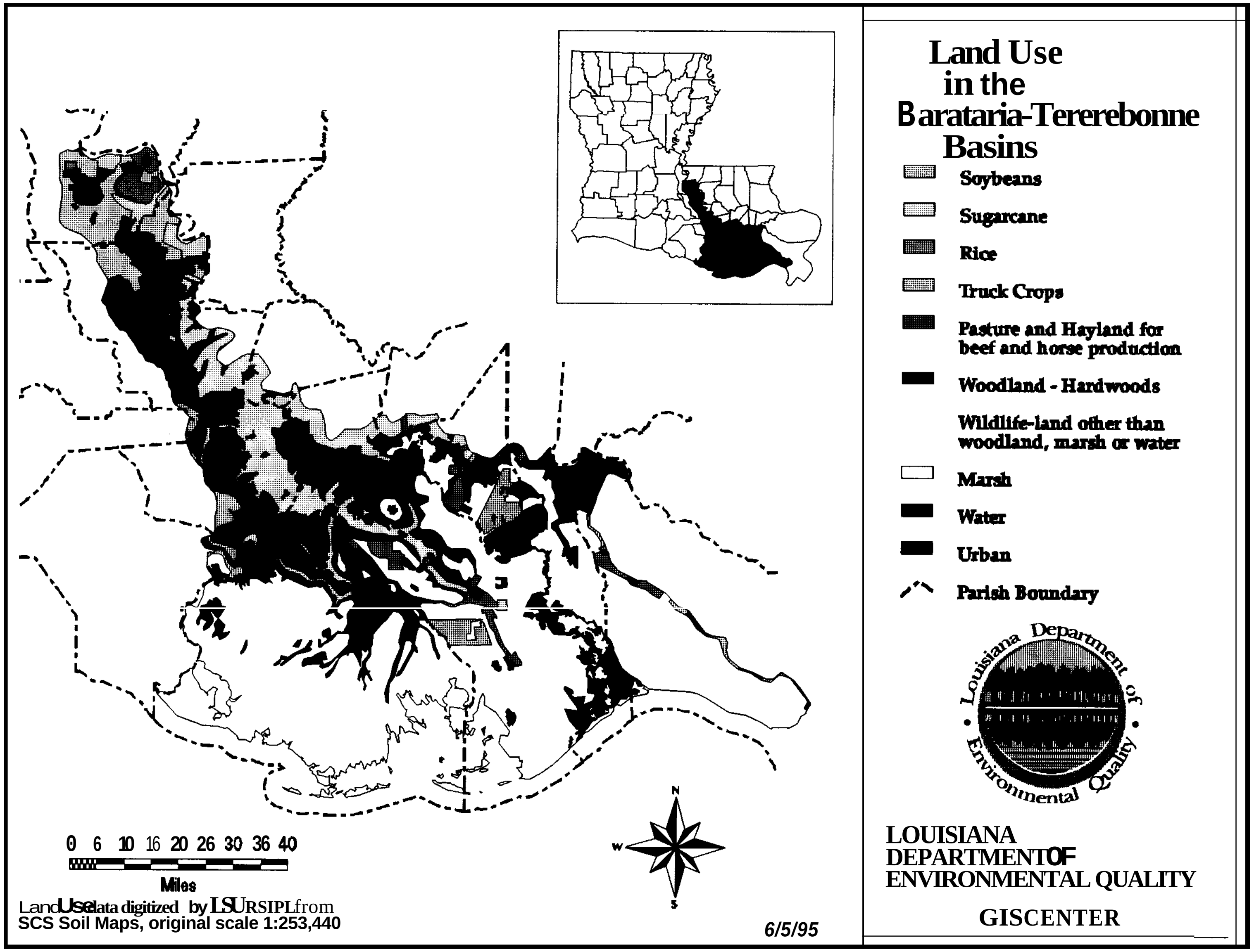


Figure 7. Land use map of the Barataria and Terrebonne basins.

Data from the National Resource Inventory for the years 1982, 1987, and 1992 indicate only slight changes in land use within the basins (table 3, U.S. Department of Agriculture 1995). These data show a continuing decrease in forest land and pasture land acreage and an increase in urban or developed land and open water.

Between 1982 and 1992 the amount of land in the system classified as urban increased by 14.4% (table 4). The increased urban land was developed from what had previously been either forest or cropland. From 1982 to 1992, 13,300 acres of forest land were converted to urban or developed use as were 9,600 acres of cropland. Water area increased by 2.3% from 1982 to 1992. By 1992, 13,300 acres of land that had been classified as minor/miscellaneous (includes marsh) in 1982 were converted to open water.

These data indicate two scenarios: one is development "pushing back" from the natural levees farther into back-swamp areas, and the other is wetland degradation and coastal "erosion" with more water area resulting. The "pushing back" phenomenon occurs where the initial cultural settlement along the natural levees encroaches on levee slopes that have been cleared for agriculture. The agricultural lands are subsequently "pushed back" further into the levee slopes and into the fringes of the back-swamp areas. The result is an increase in urban use, agricultural land use remains the same even though it has been shifted, and the amount of forest land decreases.

Natural processes including subsidence and sea-level rise contribute to the increased water area in the basins. Culturally induced hydrologic modification has in some areas accelerated the conversion of wetlands to open water. Oil and gas canal construction contributed to the increase in water area in the basin through the mid 1980s. Data from the Louisiana Department of Natural Resources indicate oil and gas activity alteration of vegetated wetlands decreased significantly from 1982 to 1986 (Morgan 1994).

The most comprehensive assessment of land use in the Barataria and Terrebonne basins and the state of Louisiana is based on high altitude, aerial photography taken in the winter of 1978–1979 and photointerpreted by the U.S. Geological Survey. The available published data are for complete parishes and provide a comprehensive assessment of how land in the basins was used by humans in 1978 (Louisiana State Planning Office n.d.). The changes likely to have occurred since the 1978 data are reflected in the U.S. Department of Agriculture data for the period for 1982–1992, which indicate only slight shifts in land use.

In 1978 wetlands accounted for 3,404,884 acres or 46.47% of the area contained within the political boundaries of the parishes wholly or partially within the Barataria and Terrebonne basins (table 5). Water covered 1,979,652 acres or 27.02% of the basin parishes. Agriculture was then ranked third in land use coverage at 1,123,054 acres or 15.33%, and forest land ranked fourth at 489,429 acres. Land classified as urban and built up land covered 304,397 acres or 4.15% of the total area.

On a parish-by-parish basis, the expanse of wetland coverage ranges from 63.35% of Lafourche Parish to 5.36% in West Baton Rouge Parish. Water coverage ranges from a low of 3.12% of Iberville Parish to 48.21% of Orleans Parish. Over half of the area of the coastal parishes and river parishes up to Ascension Parish in the basin are wetlands or water.

Table 2. Landforms, soil types, and land use acreage.

Acreage by Landforms and Soil Types–Acres*	
1. Loamy natural levees–Commerce and similar soils	512,500
2. Clayey back swamp borders–Sharkey and similar soils	344,500
3. Clayey and mucky swamplands–Fausse, Barbary, and similar soils	796,000
4. Mucky and peaty marshland, fresh water marshes–Allemands, Kenner, and similar soils	526,000
5. Mucky and peaty marshlands, brackish water marshes–Lafitte, Clovelly, and similar soils	410,000
6. Mucky and peaty marshlands, salt water marshes–Bellpass, Timbalier, and similar soils	415,000
7. Sandy barrier islands and clayey salt sea rims–Felicity, Scatlake, and similar soils	71,000
8. Mucky and clayey drained marshlands–Rita, Harahan, Westwego, and similar soils	99,000
9. Water bodies greater than 40 acres	527,000
TOTAL	3,737,000

Land Use Acres–1950**	
1. Urban and built-up areas	70,000
2. Water bodies greater than 40 acres	527,000
3. Cropland	437,000
4. Pasture	174,000
5. Forest	1,030,000
6. Marshland	1,499,000
TOTAL	3,737,000

*Acres derived from Soil Conservation Publication.
**Conservation Need Inventory Data adjusted to Soil Survey acreages.

Table 3. Land cover/use, broad categories—Barataria and Terrebonne basins: 1982, 1987, and 1992.

	Acres (in thousands)		
Cover/Use Classification	1982	1987	1992
Cropland-cultivated	487	487	491
Cropland-noncultivated	1	0	0
Federal land-cover/use	17	31	38
Forest land	810	794	779
Minor land (other rural)	1326	1308	1305
Pastureland	152	147	143
Rangeland	9	9	8
Rural transportation	43	45	46
Urban	111	124	131
Water-census-streams	538	550	554
Water-small-stream	125	123	124
Totals	3618	3618	3618

	Percent of Total Area		
Cover/Use Classification	1982	1987	1992
Cropland-cultivated	13.45	13.45	13.57
Cropland-noncultivated	0.01	0.00	0.00
Federal land-cover/use	0.46	0.86	1.05
Forest land	22.39	21.94	21.53
Minor land (other rural)	36.66	36.15	36.08
Pastureland	4.21	4.07	3.94
Rangeland	0.25	0.23	0.22
Rural transportation	1.19	1.25	1.26
Urban	3.07	3.44	3.61
Water-census-streams	14.87	15.20	15.32
Water-small-stream	3.45	3.40	3.42
Totals	100.00	100.00	100.00

Source: U.S. Department of Agriculture 1995.

Table 4. Land use/coverage acreage conversion—Barataria and Terrebonne basins: 1982 to 1992 (Acres/1,000).

Broad Cover/Use, 1992	Broad Cover/Use, 1982: Cropland	Forest Land	Minor/Misc	Pasture & Range Land	Urban & Transportation	Water	Totals	Percent Change from '82 to '92
Cropland	463.5	14.0	0.5	12.0	0.0	0.9	490.9	0.80
Forest land	2.7	769.1	0.1	0.0	0.7	6.2	778.8	-3.84
Minor/Misc.	6.2	6.0	1328.7	2.3	0.0	0.0	1343.2	0.04
Pasture & Range Land	3.4	2.1	0.0	144.7	0.0	0.4	150.6	-6.69
Urban & Transportation	9.6	11.9	0.1	1.3	153.4	0.0	176.3	14.41
Water	1.6	6.8	13.3	1.1	0.0	655.1	677.9	2.31
Totals	487.0	809.9	1342.7	161.4	154.1	662.6	3617.7	

Percent of 1982 by Use in 1992:

Broad Cover/Use, 1992	Broad Cover/Use, 1982: Cropland	Forest Land	Minor/Misc	Pasture & Range Land	Urban & Transportation	Water
Cropland	95.17	1.73	0.04	7.43	0.00	0.14
Forest land	0.55	94.96	0.01	0.00	0.45	0.94
Minor/Misc.	1.27	0.74	98.96	1.43	0.00	0.00
Pasture & Range Land	0.70	0.26	0.00	89.65	0.00	0.06
Urban & Transportation	1.97	1.47	0.01	0.81	99.55	0.00
Water	0.33	0.84	0.99	0.68	0.00	98.87

Source: U.S. Department of Agriculture 1995.

Table 5. Land use of parishes wholly or partially within the Barataria and Terrebonne basins by 1978 U.S. Geological Survey level I land use classification.

The portion of parish area used that is classified as urban and built-up ranges from 21.1% in Orleans Parish to 1.63% in Terrebonne. Human habitation in Terrebonne Parish and in the other parishes in the basin is concentrated on the natural levees that parallel rivers and bayous. Traditional measures of population density based on total area of the political jurisdiction, such as persons per square mile by parish, do not accurately portray the limitations imposed by parishes that are predominantly water and wetlands.

The Louisiana Department of Wildlife and Fisheries (DWF) manages the largest tracts of land under public ownership or control in the system. In addition to two state parks, federal agencies control property used for a wildlife refuge, a historical park, and a naval air station. The largest blocks of federal and state lands in the system are presented in table 6.

Table 6. Federal and state land ownership and control in the Barataria-Terrebonne estuarine system.

Federal	
National Wildlife Refuge	
Atchafalaya National Wildlife Refuge (Iberville, a large portion)	15,220 acres
Barataria Unit–Jean Lafitte National Historical Park	12,200 acres
Belle Chasse Naval Air Station Joint Reserve Base	3,345 acres (includes acreage covered by comprehensive easements)
State	
State Parks	
Bayou Segnette State Park	580 acres
Grand Isle State Park	160 acres
DWF Wildlife Management Areas (WMA)	
Pointe-au-Chien WMA	29,000 acres
Salvador WMA	31,000 acres
Wisner WMA (leased from Wisner Foundation)	21,621 acres

Industrial, Agricultural, Urban, and Water

Louisiana's first petrochemical plant was the Chemical Products Division of (then) Esso Baton Rouge in 1941, which primarily produced synthetic rubber for use in World War II. The state's petrochemical boom really began in the 1960s when postwar consumer demand for new products and materials increased. Louisiana became a preferred site for commodity chemical production because the state had abundant natural resources, deep-water ports for shipping, and abundant land along the Mississippi River to site large operations (Louisiana Chemical Association 1994).

The enactment of Louisiana's industrial tax exemption program in 1965 created a building boom of chemical and refining plants along the Mississippi River corridor, and a historically rural state became industrialized almost overnight. Today over 60 facilities line the Mississippi River between Baton Rouge and New Orleans, and the state produces over 25% of all U.S. petrochemicals. The disposal of these industries' hazardous wastes and the reduction of their toxic emissions remain major problems (Louisiana Department of Environmental Quality 1995, Louisiana Chemical Association 1994, Louisiana Mid-Continent Oil & Gas Association 1994). The Baton Rouge area is a nonattainment area for ozone.

In 1947 Kerr-McGee Oil Company developed the first successful offshore rig out of sight of land off of the Louisiana coast. Thus began the modern offshore oil industry in the Gulf. Because of federal-state jurisdictional disputes, it was not until congressional passage of the Submerged Lands Act and Outer Continental Shelf Lands Act in 1952 that offshore development began in earnest.

If the 1940s can be characterized as the beginning of the offshore era of petroleum development, then the 1950s should be considered the beginning of the offshore industry's marine technological revolution. In this period, boat builders installed diesel rather than gasoline engines, and designed steel rather than wooden-hulled support craft for boats working offshore. Shipyards located along waterways began fabricating vessels capable of operating offshore. In 1976, 105 Louisiana shipyards were working to meet the needs of the offshore operators. The oil and gas marine service industry has been responsible for establishing Louisiana as a world leader in building thousands of supply boats, towing-supply vessels, and large utility craft operating around the world. A trend has developed whereby boats double as tug-supply, crewboat-research, and supply-support. In 1975 nearly 300 work boats were reported operating in the Gulf of Mexico. A 1981 survey of the marine transportation fleet recorded 589 support vessels stationed in the Gulf of Mexico (Davis and Place 1983).

The increase in oil and gas development in coastal and offshore Louisiana has caused a proliferation of pipelines and pipeline canals from a state perspective. Because of this increase, pipelines now commonly share rights-of-way in Louisiana's coastal zone.

In 1981 LOOP, the nation's only deep-water oil port, was constructed 19 miles south of Fourchon in Lafourche Parish. It currently handles 12% of the nation’s daily oil imports. The technology that has been developed for very deep offshore oil and gas platforms along with the presence of LOOP will ensure that the coastal Louisiana oil support industry will continue to be viable.

The recently completed Main Pass Block 299 Freeport Sulphur mine east of the Mississippi River insures the presence of a sulphur production industry in the system at Port Sulphur. The mine has reserves estimated at 67 million tons and a life expectancy of more than thirty years (*Times-Picayune* 1990).

Agricultural land use in the system has been and continues to be controlled by three factors: (1) government policies (especially federal farm policies), (2) economics and technology, and (3) quantity of land suitable for agricultural development and habitation. Each of these factors has a cause and effect.

The government policies that affect land use in an agricultural environment are the federal farm bills enacted every five years (the 1995 farm bill is currently being drafted) that dictate what farmers can or cannot produce. Their effects can most easily be seen by comparing the trends for the state and then comparing the state to the system. The major crop grown in the system is sugarcane, which requires a well-drained to moderately drained soil. These soils occur on the natural levees of the major water bodies in the system and are easily accessible and generally the most productive. When federal farm policies restrict the number of acres to be grown, these productive soils are used and less desirable soils remain idle. The state cropland trends for 1950 through 1992 are presented in figure 8. During the mid-1950s and early 1960s, farm policy dictated a specific number of acres could be planted with cotton, rice, and sugarcane. Sugarcane is the major crop grown in the system (and represents the trend for the state), and the number of acres harvested has remained about the same (figure 8). However, during the 1950s farmers began to seek alternative crops and additional land on which to produce crops because expenses were increasing and the federal price restriction on sugar began to have an economic impact.

During the late 1950s and 1960s, production costs were relatively low but increasing. Figure 9 shows that the amount of cropland harvested remained constant through the 1960s. More powerful tractors were being built. For example, John Deere introduced its new line of tractors (4010) in the 1960s. Also, the K-G blade was introduced by James E. Kissner and Edward L. Green (of Pointe Coupee Parish) near this time. The combination of these two technologies made it possible to clear large tracts of woodland, construct surface drains for many of the heavier textured soils (Sharkey clay) of the swamps, and open new lands to production.

Land normally too wet to farm was drained by constructing surface drainage that allowed pasture land to be brought into production. This change is reflected statewide in figure 10, which shows the decreased acres of pasture statewide. The system trend is similar to that of the state (figure 9). The K-G blade impacted the entire state, and woodlands were cleared throughout the state (figure 11). The impact was not as significant in the system because of the limited area that could be cleared; there was a steady rate of woodland clearing from 1954 through 1978 (figure 11).

Because there were federal acre-restrictions on growing sugarcane, an alternative crop was sought. Increasing world population required more high-protein food materials and

1950 1954 1959 1964 1969 1974 1978 1982 1987 1992
Year

Figure **8.** Sugarcane harvested in Louisiana: 1950–1992.

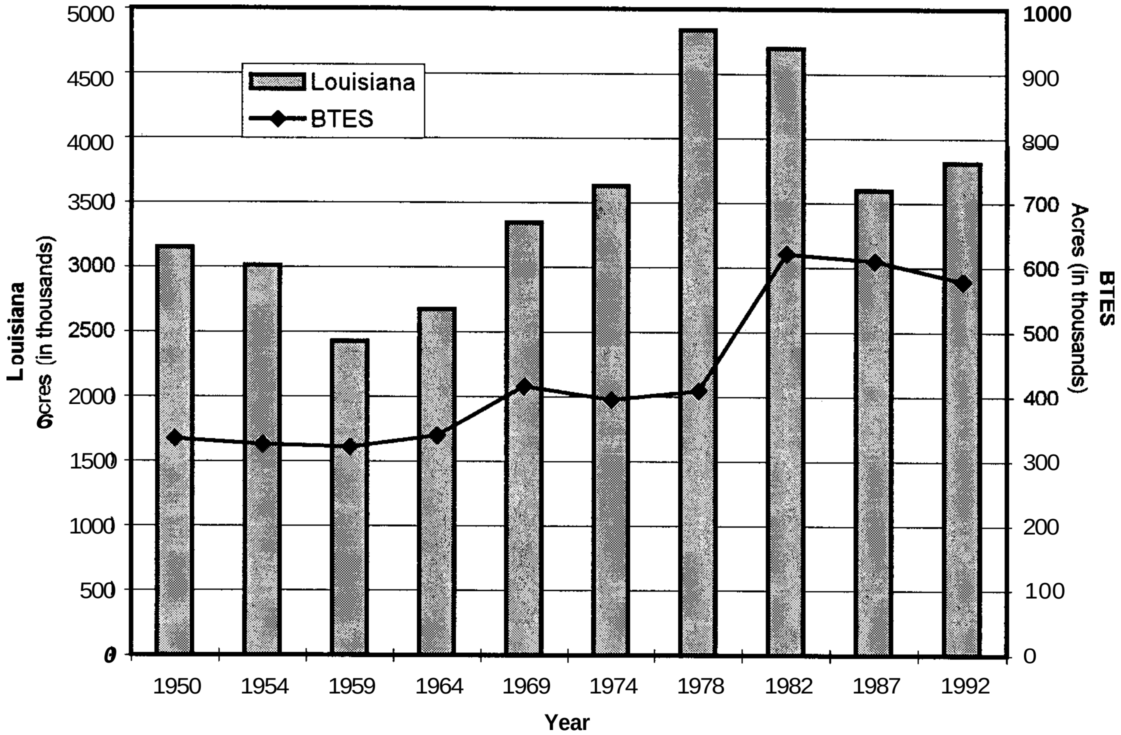


Figure 9. Number of acres of cropland harvested: 1950–1992.

created the demand for more meat animals as well as a protein supplement. Soybeans seemed to fit this need.

Soybean varieties were developed that required a short growing period, meaning that the heavier textured soils that stayed wet well into the growing season could be used economically for soybean production. Figure 12 shows that between 1964 and 1969 soybean production in Louisiana more than tripled and then doubled from 1974 to 1978. Production in the system followed the trend for the state. The upper portion of the system was one of the major areas that was cleared and planted for soybeans.

Eventually technology was introduced into South America, and Brazil and Argentina cleared vast areas of tropical forest for planting soybeans. This increased production flooded the world market and the United States could not compete. The nation's soybean acreage decreased almost overnight.

Diseases also began to decrease yields, and it became less economically feasible to grow soybeans in the United States. Figure 13 shows that within the system, soybean production has followed the state trend. Much of the land previously used for soybeans has been left idle or returned to pasture although the trends do not reflect this change in land use.

The environment became a major issue beginning in the 1970s. Global warming, protection of endangered species, nonpoint source pollution, and wetlands regulation became major national issues. Wildlife interests became alarmed when pesticides being sprayed on sugarcane fields were blamed for fish kills. Concern about the destruction of wildlife habitat, water quality, and wetlands caused the passage of Section 404 of the Clean Water Act in 1972 and the Swampbuster Act was part of the 1985 farm bill. In 1990 Congress added the Wetland Reserve Program. Federal provisions discourage agricultural development in wetlands. This legislation has had a major impact on soybean production in Louisiana. When programs are combined with prices, the acreage of soybeans continues to drop.

There have always been some restrictions on sugarcane production: acre and/or price controls. During wet autumns, the harvesting of sugarcane becomes difficult on heavy textured soil. Ratoon crop yields are lower and diseases are more severe on these clayey soils than on the better drained soils. Therefore, sugarcane production has remained essentially constant in the state (figure 9). The increased sugarcane production shown for 1992 represents the increased planting of seed cane in the Red River Valley from Bunkie to Alexandria, which has offset the decline in sugarcane acreage of the system (figure 13).

Land suitability may be defined as qualities of soil on which humans are willing to live. Within the system, the land that may be most frequently chosen on which to live consists of those soils that are protected from flooding and have physical characteristics that provide for a sturdy foundation for structures. In the system, the soils most suited are the prime farmland soils. These soils have the fewest restrictions for building and occur on the natural levees of the major tributaries, which have always been desirable habitation sites.

One way to evaluate the status and trends of urban development is to evaluate the trends for farm size. In general the farm size for most states has continued to increase.

Louisiana fits the norm. Figure 14 shows the average farm size for Louisiana and the system. Note that the farm size increased in the 1950s through the late 1970s for the state and the study area. This growth resulted from the introduction of larger equipment—especially the K-G blade—and from a decrease in people farming, and it was accomplished by the clearing of woodlands on farms in existence. However, the average farm size in the system is consistently 50–100 acres larger than the state's average size farm (figure 14). The maximum size of the farm peaked in 1974 in the system. The K-G blade was introduced in the system first, and consequently, the system was one of the first areas in which soybeans were grown.

Even though the average size of Louisiana farms, as defined by the U.S. Department of Agriculture, is still increasing, the average farm size in the system has decreased since 1982. In some parishes, such as Pointe Coupee and St. Mary, farm sizes are increasing; but in parishes that have major abandoned Mississippi River distributaries and are considered population corridors, farm sizes have decreased (i.e., comparing 1982 to 1992: Lafourche, 513 to 322 acres; St. Charles, 600 to 438 acres; Ascension, 204 to 195 acres; and West Baton Rouge, 462 to 429 acres).

This trend is likely to persist as these parishes experience continued urban growth and become the major population corridors for the system. Urban growth is the major cause for the decrease in farm size. These parishes have the highest percentage of natural levee soils, which are the best soils on which to build houses, roads, and businesses. Figure 15 presents the trend of urban growth quantified in acres. Note the tremendous increase in acres devoted to urban development from 1982 through 1992. Probably one major factor contributing to this development was the oil embargo in the late 1970s, which brought a tremendous influx of people into the system due to increased oil and gas activity in Louisiana. The oil bust of 1980 decreased the pressure for urbanization in the Barataria-Terrebonne estuarine system. The data do not reflect vacant homes or lots, just what has been changed to urban land. However, many of the people who came to the system during the late 1970s enjoyed the lifestyle and stayed in the area even after they lost their oil-related jobs. New jobs have been created in the area, and this trend is likely to continue. Farm size will decline in most parishes, and urban growth will continue. This observation raises serious questions regarding waste management, quality of life, and lifestyle in the study area.

Land use statistics of the system demonstrate that major land use categories are rural agriculture and wetlands. But human settlement statistics show a different picture. After World War II, a rural population consolidated into more urban settings as petrochemical plants and refineries were built along the Mississippi River; oil and gas industries hired workers and boat crews; and shipyards such as Bollinger, Avondale, and North American, were built. Offshore fabrication facilities were constructed from Morgan City to Lafourche Parish, and people abandoned isolated communities for the amenities of urban life. One-third of the system population can be found in Lafourche and Terrebonne parishes, either in the Thibodaux-Houma-Raceland triangle or in linear concentrations along the bayous.

Development in the Baton Rouge-to-New Orleans industrial corridor has changed from agriculture to industry on the natural levees. Petrochemical companies purchased

whole plantations and built facilities near the river. These plants are concentrated in the Baton Rouge-to-White Castle region and the St. Charles and Jefferson parish banks of the river. Farther south, support bases for offshore oil and gas production line the larger bayous such as Lafourche and Boeuf. Heliports allow for moving crews offshore efficiently, while supply bases at Fourchon, Morgan City, and Houma Navigation Canal transport the heavy equipment needed. Finally, boat yards and fabrication companies have changed fields and swamps to forests of cranes and buildings.

Future Imprints

Based on projections from 1990 census data, the population will increase for those parishes within the system from 1995 to 2000 and from 1995 to 2010 (Irwin 1994, table 7). In the short term (five years), there will be more people living in the system, and in the long term (beyond five years), there will be substantially more people living in the system. Consequently, human impact on land, water, and other resources of the system, and conflicts over human use of these resources, will increase dramatically.

Projections of future economic and population trends and discussion of federal and state legislation and institutions impacting the system are discussed in the following chapters. What is presented here is a discussion (1) on future land use trends and tools available to regional entities and local governments to affect these trends and (2) on how these trends might impact the seven priority problems. For ease of discussion, this section groups the priority problems into four broad categories: modification of hydrology; lack of sediment; habitat loss and changes in living resources; and water quality. Under these four categories, short- and long-term trends are reviewed.

The human habitat loss of such rich cultural areas as the historic communities of Isle Au Jean Charles and Marmande Ridge will have profound short- and long-term impacts on the culture and identity of people living in the system (*Times-Picayune* 1992 and 1991.)

Future Land Use Trends

Regional subsidence and local erosion are ever-present contributors to wetland loss. Through the 1993 Louisiana Coastal Restoration Plan and the 1990–1995 Coastal Wetlands Conservation and Restoration Plan (CWPPRA Plan), Louisiana is attempting to reduce the impacts of these problems and achieve no net loss of coastal wetlands. The trend of migration from rural to urban areas will continue (Larson et al. 1980), with restrictions on wetland development in swamp, marsh, and low-elevation areas due to the Section 404 permitting program administered by the U.S. Army Corps of Engineers (U.S. Department of the Interior 1994) and with restrictions added to the National Flood

Table 7. Population trends and projections by parish: 1970–2010.

Parish			Population[1]	Population Projections[2]		
	1970	1980	1990	1995	2000	2010
Ascension	37,086	50,068	58,214	64,180	64,410	74,440
Assumption	19,654	22,084	22,753	24,100	29,970	27,150
Iberville	30,746	32,159	31,049	31,390	32,050	24,100
Jefferson	337,568	454,592	448,306	465,560	478,190	513,980
Lafourche	68,941	82,483	85,860	92,610	96,090	104,810
Orleans	593,471	557,927	496,938	481,820	87,770	514,740
Plaquemines	25,225	26,049	25,575	26,850	27,630	29,820
Point Coupee	22,002	24,045	22,540	22,210	22,500	23,670
St Charles	29,550	37,259	42,437	46,290	48,390	53,200
St James	19,733	21,495	20,879	21,160	21,650	23,140
St John	23,813	31,924	39,996	43,360	43,380	49,950
St Martin	32,453	40,214	43,978	46,270	47,810	51,710
St Mary	60,752	64,253	58,086	57,440	57,950	60,780
Terrebonne	76,049	94,393	96,982	102,060	105,140	113,280
W. Baton Rouge	16,864	19,086	19,419	19,700	20,120	21,420
BTES Total	1,393,907	1,558,031	1,513,012	1,545,000	1,583,050	1,686,190

[1]Source: U.S. Bureau of the Census 1972a, 1982a, and 1992a.
[2]Source: Irwin 1994.

Insurance Program by Title V of the Riegle Community Development and Regulatory Improvement Act of 1994 (U.S. Congress 1994).

In addition, there will be an increasing trend of less habitation, development, and agricultural use in the swamp, marsh, and low-elevation areas, and an increasing shift of habitation and development to natural levee ridges. The projected system populations that increase on the natural levees will increase population density, intensify competing demands for land usage, increase solid waste and sewage output, increase demand for localized public services, and increase demand on drinking water supplies (Louisiana Department of Transportation and Development 1984, South Central Regional Planning Commission 1980).

Industrial development along natural levee ridges may be impacted by the new concept of "environmental justice" (Louisiana Department of Environmental Quality

1994). Fishing, trapping, and recreational camps will remain outside the natural levees. The use of marsh management plans by coastal landowners is expected to increase (U.S. Department of the Interior 1989, Cahoon and Groat 1990, Morgan 1994).

As oil and gas exploration and development efforts in Louisiana's coastal and territorial waters continue to decline, deepwater drilling technology will ensure continuing exploration, development, and production on the OCS offshore Louisiana (*Advocate* 1995). The Louisiana petrochemical and refining industries are expected to be in an expansion mode for the next few years (*Sunday Advocate* 1995). Seafood processing plants and offshore oil-and-gas support industries will continue to locate on the natural levee ridges.

A full suite of federal and state regulatory programs affects these land use shifts. Tools are available to units of local government in the system (i.e., parishes and municipalities) and regional entities, that will have to deal directly with the burden of these shifts in land use. These tools will be the constitutional (Article VI, Sec. 16, 1974 La. Constitution) and legislatively granted powers for managing competing land uses in local government areas: planning for use growth on a parish, municipal, or regional level; and implementing these plans by zones for various uses, e.g., residential, commercial, industrial, rural (La. R.S. 33:106, et seq; R.S. 33:131, et seq; R.S. 33: 140, et seq; R.S. 33:1236, et seq; and R.S. 33:4721 et seq).

Many parishes and municipalities have planning departments, directors, and/or commissions (Emmer et al. 1992b, Moore 1994; table 8). Most of the system parishes (and numerous other Louisiana parishes) wrote master plans for development in the late 1960s and early 1970s that were federally funded pursuant to Section 701 of the federal Housing Act of 1954. These plans and the data and methodology on which they were based, however, are obsolete (Emmer et al. 1992b, Moore 1994).

The majority of the system parishes are located in geographic areas served by four of the state's regional planning commissions: the South Central Regional Planning Commission, encompassing the mid-to-lower estuarine system; the Capital Regional Planning Commission, covering the northern system parishes; the Regional Planning Commission, including Jefferson, Plaquemines, Orleans parishes; and the Acadiana Regional Planning Commission, encompassing St. Mary Parish. The regional planning commissions are required to prepare, periodically, regional development plans recommending policies to the parishes and municipalities for development of the region.

The regional commissions have no zoning authority (Emmer et al. 1992b). Most of the system parishes have parish zoning ordinances and subdivision regulations. Likewise, a majority of estuarine system municipalities have zoning ordinances and subdivision regulations (Emmer 1992b, Moore 1994; table 8).

Impacts on Priority Problems

Hydrology Modification. Because of federal laws and institutions (see next section) that restrain development on wetlands and limit population shifts to the natural levees, demand could increase for construction of flood protection levees at the back edge of the natural levees where they currently do not exist. Freshwater diversion projects under the federal and Louisiana coastal restoration plans also could increase the demand for protective levees. Any increase in the flow of Mississippi River water into Bayou Lafourche would require extensive dredging of the bayou— otherwise flooding problems along its route will increase. There also will be a need for new streets and roads, and their construction might alter hydrology in certain areas.

The continued use of marsh management plans (given the sanction of the Louisiana Coastal Restoration Plan) could continue to disrupt historic public access to waterways and canals and lead to conflict (Davis 1993). The 5,000-acre mariculture permit program managed by the Louisiana Department of Wildlife and Fisheries (La. R.S. 56:579.1 et seq.) will have significant impacts on the system.

Lack of Sediment. Federal and state plans for freshwater diversion projects will increase available sediment; however, the benefits of this increased sediment will be balanced against the global sea-level rise. Moreover, the question will arise concerning who will own newly filled land. Louisiana's Constitution, Civil Code, and public trust principles could lead to much litigation over this issue. The recent state–the Louisiana Land and Exploration Company disagreement over ownership of land to be reclaimed through CWPPRA on Isles Dernieres indicates that this question could generally be difficult to resolve (Hribernick and Wascom 1982, Wilkins and Wascom 1992, Louisiana State Law Institute 1992).

Habitat Loss. Aside from the beneficial effects of federal and state projects introducing new sediment, there is the question of land loss and land subsidence on future agriculture. The incentives for wetland maintenance and restoration on agricultural lands (established by the federal Food Security Act of 1985 and the Food, Agricultural, Conservation, and Trade Act of 1990) will provide assistance to those who must cease production on their agricultural lands and help maintain current wetland acreage on agricultural lands. Through the Wetland Reserve Program, available wetland acreage could actually be increased by allowing owners of agricultural property to retain ownership of the land subject to a permanent wetland protection easement and by paying up to the fair market-value for property devalued by the easement (Payne 1993).

With respect to fisheries resources, the short-term impacts of the CWPPRA Plan and the state Coastal Restoration Plan would be on the change in salinity levels in the lower part of the system’s fresh water, particularly in oyster grounds and shrimp and finfish nursery areas. Lower salinities in current oyster grounds will displace oystermen from their current areas of operation.

In the long term, it is anticipated that the CWPPRA and the state Coastal Restoration Plan will rebuild lost nursery habitat and decrease the loss of new habitat. The increase in nursery habitat in the lower estuarine system should benefit all system fisheries.

The CWPPRA and state Coastal Wetlands Plan will help to retard land loss on the system's barrier islands. The federal Coastal Barrier Resources Act will prevent government-subsidized new development on these system islands, with the exception of the only developed barrier island, Grand Isle.

Water Quality. In the short and long term, drinking water supplies—drawn for the most part from the Mississippi River—should be plentiful (Louisiana Department of Transportation and Development 1984, South Central Regional Planning Commission 1980). The extension of a freshwater line from lower Jefferson Parish to Grand Isle should take care of the latter's short- and long-term water needs.

In the short and long term, the effects of human use of the land will have significant impacts on the quality of surface drinking water supplies, and the water quality of the system water bodies, swamps, and marshes will be a significant concern (Louisiana Department of Environmental Quality 1994).

As noted above, the water quality impacts of CWPPRA and the state Coastal Restoration Plan freshwater diversion on salinity levels cause concern, as does the quality of water diverted from the Mississippi River. Should the Mississippi's flow into Bayou Lafourche be increased, the same water quality concerns would arise.

In the short and long term, population increases and additional agricultural development on natural levees will increase the nonpoint-source pollution runoff into the estuarine system water bodies. Increased production of solid waste will increase the possibility of leachate runoff from landfills and increased sewage output. The state's integrated regional solid waste management plan, with its emphasis on regional landfills with selected pickup sites, should adequately handle the system's increased solid waste in the short and long term and reduce the leachate runoff problem (Louisiana Department of Environmental Quality 1993b).

Increased flow into publicly owned treatment facilities could be adequately planned for and handled in the short and long term provided the local wastewater district can get necessary treatment improvements funded through the Municipal Facilities Revolving Loan Fund (Louisiana Department of Environmental Quality 1994). Untreated sewage from residences and camps will continue to pose problems in the short and long term.

Control of nonpoint-source pollution from municipal and agricultural runoff is being encouraged through the nonpoint-source education of the Louisiana Department of Environmental Quality (LDEQ) pursuant to Section 319 of the Clean Water Act (Louisiana Department of Environmental Quality 1993b). The Coastal Nonpoint Source Pollution Program will require mandatory nonpoint control measures on uses inside or outside the legislatively defined Louisiana Coastal Zone that affect coastal water quality.

It will have long-term beneficial impacts on the estuarine system water quality if it is implemented and continues to exist.

Conclusion

As noted at the outset, the tools available to the system's people for anticipating and adjusting to the increased land use demands on the natural levees are in place: the regional planning commissions, the parish/municipality planning departments and/or commissions, the Louisiana Coastal Resource Program, the four local coastal management programs, the Barataria-Terrebonne National Estuary Program (BTNEP) Comprehensive Conservation Management Plan. However, they must be used. And the development of regional/local-based management of increasing and conflicting land uses can be accomplished in the short and long term by the judicious use of legislatively granted zoning powers by the parishes and municipalities.

Zoning is not uniformly popular. But if used as a tool to implement regionally or locally based and supported plans for the future of an area, it can be an effective method of resolving these use-conflicts at a local level rather than having them resolved at the state or federal level.

There is a need for cooperation between the regional/parish/municipality planning bodies to accomplish a future development plan for the citizens of the system. The Comprehensive Conservation Management Plan for the system and the establishment of the Barataria-Terrebonne Foundation (Barataria National Estuary Program 1995) will assist these entities and the current and future residents to visualize and to achieve their hopes for the system's future.