ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

FEASIBILITY STUDY

VOLUME 1

MAIN REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SYLLABUS

The purpose of the study was threefold: to review the Atchafalaya Basin Floodway feature of the Mississippi River and Tributaries (MR&T) project to develop an implementable plan for safely passing its share of the project flood; to review the operation of the Old River control structure to determine if changes in operation of that feature were warranted; and to develop a comprehensive plan for the management and protection of the water and related land resources of the Atchafalaya Basin. The US Army Corps of Engineers was assisted in the study by the active participation of the US Environmental Protection Agency, the US Fish and Wildlife Service, and the State of Louisiana.

The Federal flood control project, which drains some 41 percent of the continental United States, is currently incapable of passing the project flood. At the same time, there is the recognition both on a local and a national level that the Atchafalaya Basin is a unique ecosystem deserving of protection. This report serves as a survey report for those study features requiring congressional authorization, generally those relating to environmental preservation, and a Phase I general design memorandum for those features previously authorized by the Congress, generally the flood control features.

Numerous alternatives were considered in order to address the primary study goals of flood control and environmental protection. Separable plan features were considered to be responsive to individual problem areas, and certain features were combined to form an optimum comprehensive multipurpose plan. To this end, the study addressed management measures for the distribution of flows between the Mississippi and Atchafalaya Rivers; the safe conveyance of floodflows through, and reduction of sedimentation in, the Lower Atchafalaya Basin Floodway; the safe conveyance of floodflows through the outlets to the Gulf of Mexico; the protection of the area east of the lower floodway from backwater flooding; and, the protection or enhancement of fish, wildlife, and recreation resources in the lower floodway and project-affected areas.

The Recommended Plan provides for maintaining the existing Old River flow distribution of 70 percent down the Mississippi River and 30 percent down the Atchafalaya River; channel training for main channel and outlets development, sediment control measures and reestablishing, over time, the approved outlet distribution for passing the project flood through the Bayou Teche Ridge to the Gulf of Mexico; implementation of extension of the Avoca Island levee and/or other structural or nonstructural measures to provide protection to the backwater area east and northeast of Morgan City after completion of additional engineering and biological studies; establishing two management units initially, and possibly others in the future, to manage water levels for improvement of aquatic resources; and a

comprehensive real estate feature including, among other provisions, flowage and developmental control easements, environmental protection easements and additional state lands acquired through donation and purchase to optimize public access to the unique environmental features of the basin; and, recreational development features complementary to the added public access.

The total cost of the Recommended Plan, including remaining work to modify existing authorized features to pass the project flood, is $988,006,000. No cost benefit-cost ratio for this plan was developed since the flood control features are integral parts of the comprehensive MR&T project. The first cost of nonflood control features is estimated to be $220,113,000; the average annual cost $18,508,000; the average annual benefits $18,659,000; and the benefit-cost ratio 1.01. The average annual excess of benefits over costs is $151,000. It is recommended that first costs of $936,797,000 be borne by the Federal Government with non-Federal interests bearing a cost of $51,209,000, primarily for real estate features. It is further recommended that the environmental and recreational features be operated and maintained by the State of Louisiana. Operation and major maintenance of all flood control features would remain a responsibility of the US Army Corps of Engineers.

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MAIN REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT

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DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT. CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS. LOUISIANA 70160

LMNPD-C

15 January 1982

SUBJECT: Atchafalaya Basin Floodway System, Louisiana

President
Mississippi River Commission

INTRODUCTION

The Atchafalaya Basin study combines pre-authorization studies of some project features with post-authorization studies of others. Thus, the study report is a combination Survey Report and General Design Memorandum (GDM), respectively. This distinction is necessary because the survey scope features of the Recommended Plan will require authorization by the US Congress prior to implementation, while the other features of the plan may be implemented under existing authorities.

The area encompassed by the study is located in south-central Louisiana, and extends from the vicinity of Monroe, Louisiana, southward to the Gulf of Mexico (see Figure 1). It includes the Red River backwater area, the Atchafalaya Basin Floodways, and the Atchafalaya Bay - west Terrebonne Parish marsh-backwater area complex. Plate 1 shows significant physical features of the floodway system as it presently exists. A familiarization with locations of the following key items on Plate 1 will aid the reader in better understanding the information presented in this report.

- Mississippi River
- Old River
- Red River
- Atchafalaya River (Main Channel)

- West Atchafalaya Floodway
- Morganza Floodway
- Lower Atchafalaya Basin Floodway
- Old River Control Complex
- Morganza Control Structure
- Interstate Highway 10 (I-10)
- East and West Atchafalaya Basin Protection Levees
- East and West Atchafalaya River Levees
- Krotz Springs, Louisiana
- Morgan City, Louisiana
- Wax Lake Outlet
- Lower Atchafalaya River Outlet
- Atchafalaya Bay
- Terrebonne Parish Marsh.

The primary study goal has been to develop an implementable multipurpose plan that will protect southeast Louisiana from Mississippi River floods by ensuring safe passage of one-half the project flood through the floodway system, while retaining and restoring the unique environmental values of the floodway and maintaining or enhancing the long-term productivity of the wetlands and woodlands. To this end, the study addressed management measures for the operation of the Old River control structure; the safe conveyance of floodflows through, and reduction of sedimentation in, the Lower Atchafalaya Basin Floodway; the safe conveyance of the floodflows through the outlets to the Gulf of Mexico; the protection of the area east of the lower floodway from backwater flooding; and the protection or enhancement of fish, wildlife, and recreation resources in the lower floodway and project-affected areas.

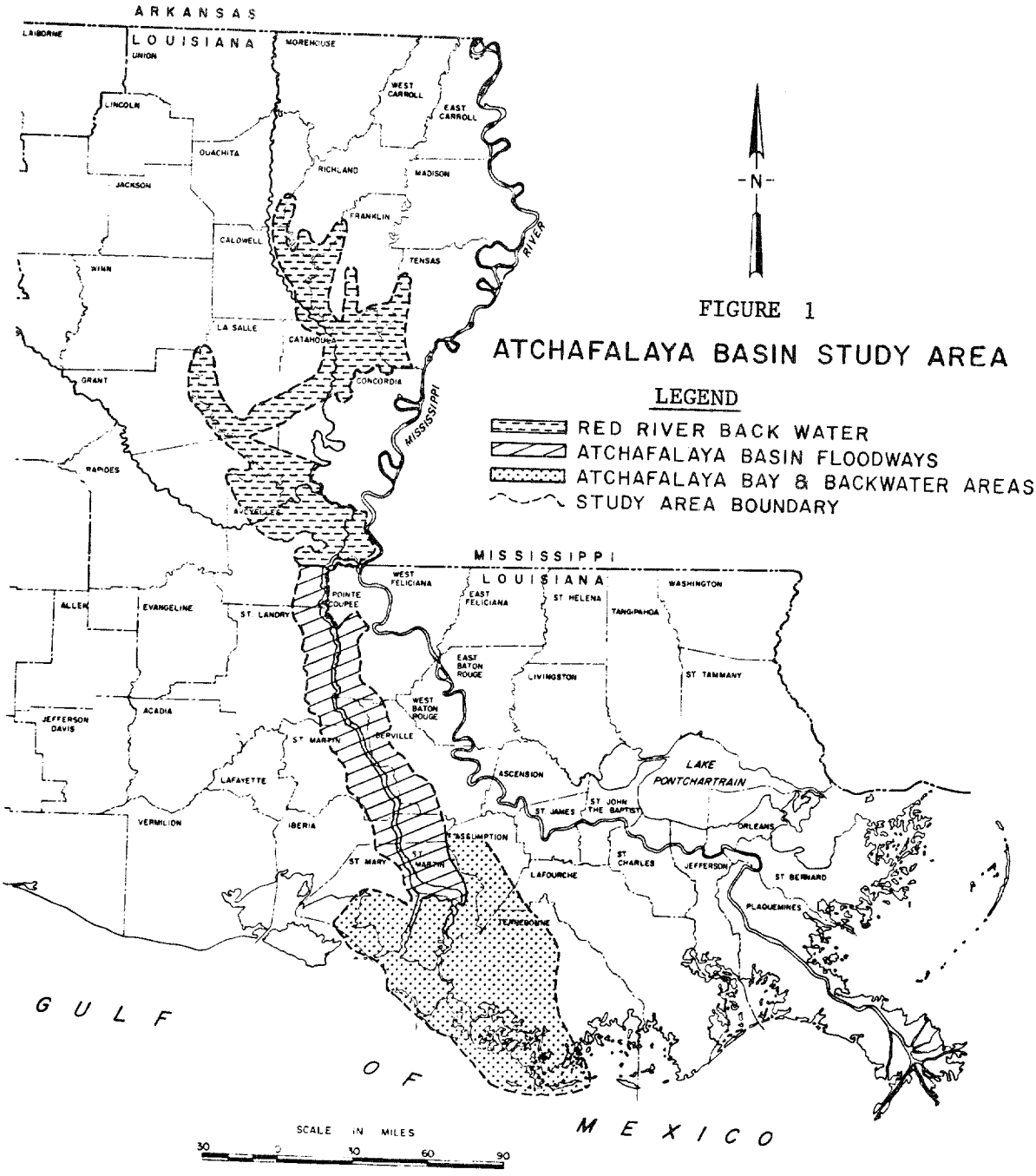


FIGURE 1

ATCHAFALAYA BASIN STUDY AREA

Study Background and Scope

The lower Mississippi Valley conveys the floodwaters originating in 41 percent of the continental United States to the Gulf of Mexico through the Mississippi River system. In 1927, a flood of unprecedented magnitude occurred on the Mississippi River, inundating some 16,500,000 acres in seven states and causing damages amounting to over one billion of today's dollars. An even greater loss was the 214 persons who perished in the flood. In response to this major disaster, the US Congress passed the Flood Control Act of 1928. That act directed the US Army Corps of Engineers to develop and implement a plan to prevent further damages and loss of life from floods on the Mississippi River system. Since that time, the US Army Corps of Engineers has developed the comprehensive Mississippi River and Tributaries (MR&T) project to provide flood protection in the alluvial valley of the Mississippi River from Cape Girardeau, Missouri, to Head of Passes, Louisiana.

The Atchafalaya Basin Floodway system, a prominent feature of the MR&T project, extends from the proximity of Old River, at the juncture of the Red and Mississippi Rivers, to the Gulf of Mexico.

The existing floodway system consists of three separate floodways: to the north are (1) the West Atchafalaya Floodway and (2) the Morganza Floodway with its control structure, both of which along with the Atchafalaya River, pass floodwaters into (3) the Lower Atchafalaya Basin Floodway (see Plate 1). These structural modifications have been made to the natural Atchafalaya Basin for the purpose of passing its share of a project design flood on the MR&T system. Translated to river flow rates, the design flood equals 3 million cubic feet per second (cfs) at the latitude of Old River, the head of the Atchafalaya River distributary and Atchafalaya Basin Floodway system. The floodway system must be capable of safely passing one-half, or 1.5 million cfs (see Figure 2), to the gulf in order to avert floods along the highly populated, industrialized corridor of the lower Mississippi River.

The principal features of the floodway system that have been developed to date are: protection levees forming the eastern and western boundaries to contain the floodwaters; an improved and partially leveed main channel to assist in transporting water and sediments more efficiently; and two outlets--the Lower Atchafalaya River and Wax Lake Outlet--to pass the floodwaters from the floodway to the gulf. The project also includes bank stabilization; navigation improvements; freshwater distribution channels; and numerous locks, floodgates, pumping stations, levees, and other features which provide improvement of local drainage affected by the project and local backwater protection. Currently, the Atchafalaya Basin Floodway

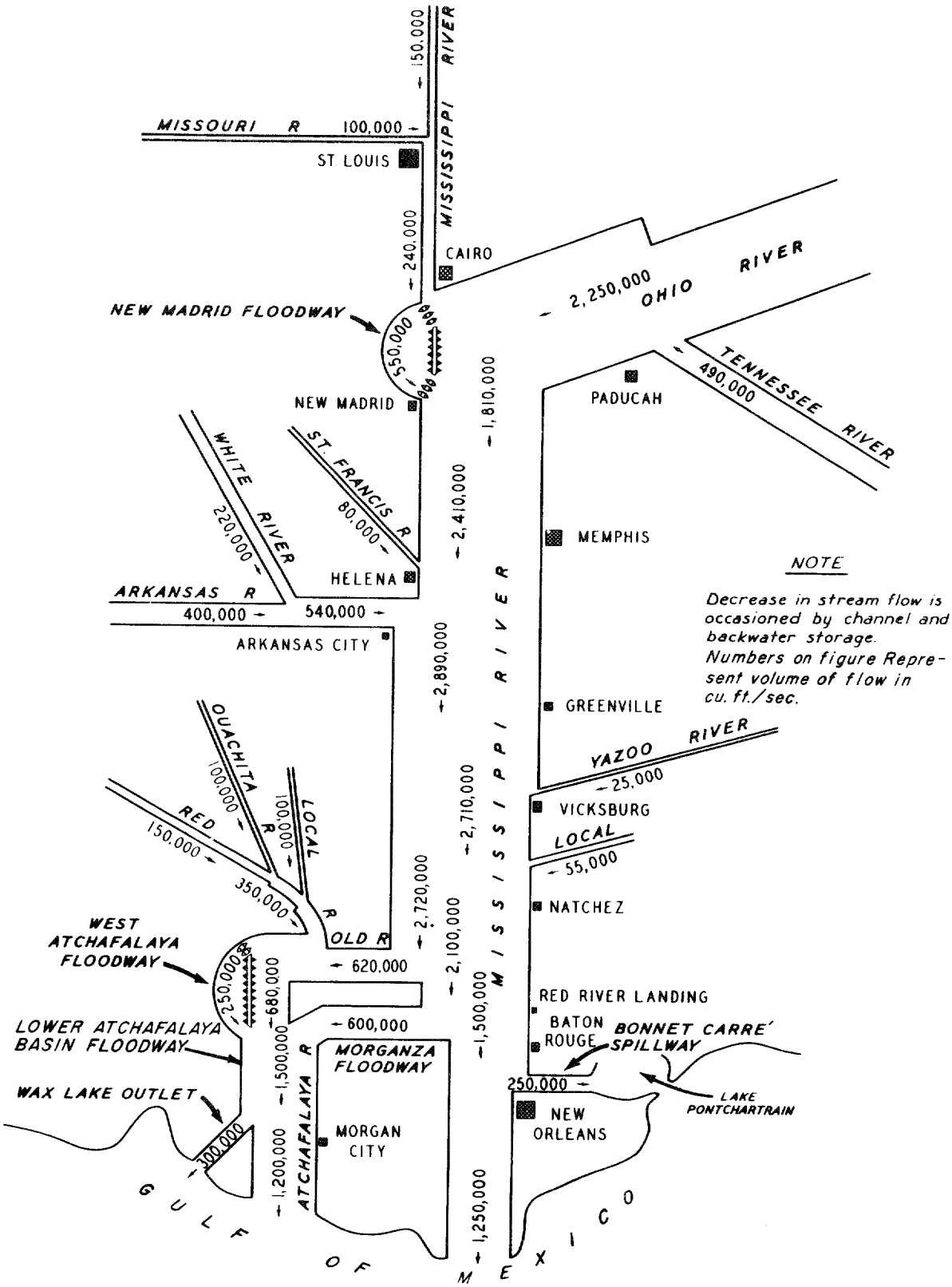


FIGURE 2 PROJECT DESIGN FLOOD

system can safely accommodate only about 60 percent of its assigned share of major floodflows. Until the flood control project is completed, much of south Louisiana remains vulnerable to flooding.

A history of the early natural formation and the later influences of man on the development of the Atchafalaya River and Basin is included in Appendix A of the report. The first significant structural changes by man consisted of levee building. By 1910, local interests had completed levees to confine the river as far south as Krotz Springs, Louisiana. After the Flood Control Act of 1928, a program for dredging the river south of the leveed segment was carried out between 1932 and 1940. Its purpose was to improve the flow capacity of the river by providing a single, centrally-located channel through the interlaced, meander bayous and streams of the lower basin. The Wax Lake Outlet channel was completed in 1941 to provide a second outlet for flow through the marshes to the south.

In 1954, a systematic program was begun to accelerate maturation of the Atchafalaya River main channel in reaching its estimated self-maintaining size of 100,000 square feet (sf) in cross-sectional area. The program involved the progressive confinement of normal river flows to the main channel by dredging to increase flow capacity, placing dredged material intermittently along the river's banks to aid confinement, and closing off some 22 distributary streams. These improvements in main channel capacity were directed at minimizing the need for increasing the heights of the East and West Atchafalaya Basin Protection Levees.

Studies undertaken shortly after World War II indicated that an ever increasing amount of Mississippi River flow was being diverted down its Atchafalaya River distributary, the shorter course to the gulf. If left to nature, complete rerouting of the Mississippi was projected to occur by about 1975, and would leave the lower Mississippi River a deep saltwater estuary of the gulf with no freshwater flows except during major floods. The impact of a course change would be catastrophic from an economic and social standpoint, since southeast Louisiana has been developed around the existence of the lower Mississippi in its present course. Studies by the Mississippi River Commission indicated that a diversion of flow, which would allow 70 percent of the total latitude flow at Old River to remain in the Mississippi River and 30 percent to go down the Atchafalaya, would promote stability of the system. The Old River control structure was completed in 1963 to provide for regulating flows to achieve this 70/30-percent flow division.

Dredging of the central or main channel was halted in 1968 because of limited funds. The next year, the National Environmental Policy Act was passed by the US Congress, requiring the preparation of an environmental impact statement (EIS) for such projects. By that time, the dredging of the main channel had become an environmentally

sensitive issue. Subsequently, an agreement was reached between the US Army Corps of Engineers and the National Wildlife Federation (NWF), whereby the US Army Corps of Engineers agreed to cease dredging work on the main channel until an EIS for the project was completed. The NWF agreed not to oppose the construction of the remaining features of the project and to assist the US Army Corps of Engineers in preparing the EIS. Thus, work has continued to raise the project levees, while the Atchafalaya River main channel has continued to develop and enlarge only by natural means.

Study Authority

Pre-authorization studies affecting the Atchafalaya Basin were first launched in June 1968, when the Committee on Public Works of the United States Senate, at the request of agricultural interests from the Red River backwater area, adopted a resolution authorizing the US Army Corps of Engineers to review the Old River control system and its operation to determine whether either or both should be modified. Four years later, in March 1972, the Senate Committee adopted another resolution at the request of interests from the lower floodway area, this time authorizing the US Army Corps of Engineers to develop a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin. A companion resolution was adopted by the House Committee on Public Works in June of that year. Verbatim citations of these study authorities are contained in Appendix A.

The phase I GDM, or post-authorization study, was authorized in June 1976 under the discretionary authority of the Secretary of the Army acting through the Chief of Engineers. This provided for a study to address alternative plans for accomplishing the previously authorized purposes of the Atchafalaya Basin, Louisiana, project.

Because of interrelationships between the studies authorized by the US Congress and those authorized by the Chief of Engineers, they were combined into a single study to develop a comprehensive multipurpose plan for the Atchafalaya Basin Floodway system.

Study Participants and Coordination

As indicated earlier, prior to the study authorizing resolutions of 1972, the US Army Corps of Engineers was constructing, by dredging,

an enlargement of the Atchafalaya River main channel. This dredging was first halted in 1968 by a lack of funds and later by the lack of an EIS. In 1971, the Chief of Engineers reached an agreement with the Executive Director of the NWF to cease dredging of the main channel until an EIS for the project was filed with the Council on Environmental Quality. In turn, the NWF agreed not to contest work on other project features, such as levee raisings, while the EIS was being prepared. Further, the NWF agreed to assist in the preparation of the EIS to bring an "environmental awareness" to the effort.

Following that agreement, a multi-interest, interdisciplinary approach to the preparation of the EIS was begun. The Atchafalaya Basin Steering Group was formed to oversee the effort and functioned primarily as an advisory group, with the primary work being performed by the US Army Corps of Engineers. The Steering Group was chaired by the US Army Corps of Engineers, with membership including representatives of: the NWF; the Louisiana Department of Transportation and Development, Office of Public Works (OPW); the Louisiana Wildlife and Fisheries Commision; the US Department of the Interior, represented by the US Fish and Wildlife Service (US FWS); the US Environmental Protection Agency (US EPA); and the Louisiana State University, School of Environmental Design.

In December 1974, a preliminary draft EIS was completed. A public meeting was subsequently held (January 1975) to discuss the document. Following that meeting, the Steering Group developed a conceptual multipurpose plan for the Lower Atchafalaya Basin Floodway. No details were developed on how the plan would or could be implemented. The US Army Corps of Engineers began addressing the multipurpose plan under pre-authorization authorities while preparing the draft EIS for the Lower Atchafalaya Basin Floodway project in a separate effort. At this point, the studies were generally of reconnaissance scope.

In February 1976, the draft EIS was completed and forwarded to the Office of the Secretary of the Army. Prior to public release, the Assistant Secretary of the Army for Civil Works, after meeting with national and local interests primarily concerned with conservation and wildlife, decided not to release the draft document. As a result of that decision, the Director of Civil Works of the Office of the Chief of Engineers directed that studies be made to address both the authorized and unauthorized features of the floodway project for resource preservation and management. This directive, in effect, combined the pre-authorization studies with the phase I GDM studies. These combined studies have culminated in this report.

Since that time, the Steering Group has been inactive, and management of the current studies was conducted by an Agency Management Group headed by the District Engineer, New Orleans District, US Army Corps of Engineers and included representatives of

the US EPA, represented by both its Region VI office in Dallas, Texas, and the Environmental Monitoring and Support Laboratory in Las Vegas, Nevada; the US Department of the Interior, represented by the US FWS offices in Lafayette, Louisiana, and Jackson, Mississippi; and the State of Louisiana, represented by the Department of Transportation and Development, OPW, and the Office of the Governor. The US Army Corps of Engineers had the responsibility of coordinating the study, conducting engineering, socioeconomic, and environmental studies, consolidating information from other agencies and interested parties, and preparing the report. The US FWS conducted fish and wildlife studies, assisted in formulating alternative plans, and aided in assessment of the fish and wildlife impacts of the various alternatives in accordance with the Fish and Wildlife Coordination Act. The US EPA conducted a number of hydrologic and hydraulic studies, assisted in formulating plans, and aided in assessment of the impacts of the alternatives on water quality. The State of Louisiana participated in all facets of the study and assisted in plan formulation. Other interests, including landowner representatives, hunting clubs, the National Marine Fisheries Service, and the NWF, participated in the study in an advisory role.

Throughout the course of the study, many informal meetings and field investigations were conducted for the purpose of fully coordinating with all interests; determining problems, needs, and opportunities; and assessing the impacts of alternate plans. Agency Management Group representatives met often to discuss the various aspects of the study.

Public Involvement

In the early stages of planning, formal public meetings were held to determine the desires of local interests. At these meetings, local interests described the extent of development that had occurred as a result of protection from Mississippi River floods and requested that completion of authorized projects be expedited. Local organizations of sportsmen stated that their expressed purpose was not to oppose flood control but to protect and preserve fish, wildlife, and recreation resources. Meetings were held in Vidalia, Louisiana, on 21 November 1968; Lafayette, Louisiana, on 19 December 1968, New Orleans, Louisiana, on 19 December 1968; Morgan City, Louisiana, on 15 October 1971; and Lafayette, Louisiana, on 25 January 1975. The areas of concern voiced at the meeting in Lafayette in 1975 set the tone for the studies presented in this report. Those concerns were as follows:

- There was recognition of the reality of flood threat to the area and awareness of the urgency for dealing with it.

- There was widespread concern by both proponents and opponents of the plan over the adequacy of the protection afforded Morgan City, Berwick, and other communities located at the lower end of the floodway system.

- There was not an overall appreciation of the degree to which natural forces were operating to foreclose future options with respect to environmental management within the lower floodway.

- There was widespread acceptance of the view that not enough had been done in previous years to preserve the natural values within the lower floodway and that more needed to be done.

In January 1979, public meetings were held in five Louisiana cities (Baton Rouge, Jonesville, New Orleans, Lafayette, and Morgan City) to present 10 comprehensive plans, developed by the Agency Management Group from a large array of alternative features, for public comment. Attendance at these meetings was more than 5,000, and approximately 25,000 comments were received. The primary focus of those meetings was the issue of Federal acquisition of 443,000 acres of privately-owned lands in the Lower Atchafalaya Basin Floodway for the establishment of an "Atchafalaya Fish, Wildlife and Multi-Use Area," an independent proposal developed and publicized by the US FWS.

On 27-28 March 1980 and again on 17 November 1980, representatives of environmental organizations, hunting clubs, the oil and gas industry, the League of Women Voters, public hunting organizations, landowner associations, sport fishing clubs, commercial fishing interests, agricultural interests, timber interests, and minority groups were invited to attend formal Agency Management Group meetings for the purpose of keeping their respective constituencies informed about the status of Atchafalaya Basin study planning efforts.

National level interagency meetings were held in Washington, DC, in November 1979, April 1980, and November 1980, for the purpose of discussing the status of studies on the Atchafalaya Basin. These meetings were attended by representatives of all Federal agencies having an interest in the studies. National officers of several environmental organizations attended, as well as State of Louisiana officials.

Public meetings to review the Tentatively Selected Plan in the draft report and draft EIS for this study were conducted in July 1981 in the same five Louisiana cities as in the 1979 meetings.

Discussions relative to comments received on individual features of the Tentatively Selected Plan appear later in this report under descriptions of recommended plan features and in Appendix J. In general, public support was voiced for all major plan features as proposed, except for those concerning reduction of backwater flood

damages east of the lower floodway and the public access portion of the real estate plan. Substantial numbers of adverse comments were received on these two proposals.

Participation Acknowledgment

The US Army Corps of Engineers gratefully acknowledges the help and support of numerous agencies, groups, and individuals who provided information, comments, and assistance in this important water resource study. Particular note should be made of the contributions of the members of the Atchafalaya Basin Agency Management Group, the State of Louisiana, the US EPA, and the US FWS.

Implementation of the Recommended Plan presented in this report will satisfy the critical flood control needs of the southeast Louisiana area and optimize the protection of the Lower Atchafalaya Basin Floodway, the major objectives of this comprehensive multi-purpose plan.

Studies of Others

Because of the degree of interagency involvement in this investigation, particularly from an environmental standpoint, a number of studies have been undertaken by other Federal agencies. Studies by the US FWS, funded in part by the US Army Corps of Engineers, are listed in Appendix A. These studies involved a wide variety of the biologic resources of the basin. The US EPA has completed several hydraulic, water quality, and productivity studies in the basin, which are also itemized in Appendix A.

The Study Process and Report

THE STUDY PROCESS

Studies conducted by the US Army Corps of Engineers normally follow a three-stage process in which the four functional planning tasks of problem identification, formulation of alternatives, impact assessment, and evaluation occur within the framework of each stage.

Stage 1 studies are reconnaissance level, stage 2 involves development of intermediate plans, and stage 3 concludes the general investigation process with development of detailed plans.

In this study the planning process was modified to facilitate the integration of the extensive degree of interagency involvement and coordination and the unusual combination of pre-authorization scope studies with post-authorization studies. The four functional planning tasks were carried out in the intermediate and detailed planning levels with the coordination of the interagency Agency Management Group, whereas, reconnaissance scope studies were performed under the auspices of the interagency Steering Group.

The next step in the study process is the review of the final report and EIS by higher US Army Corps of Engineers authorities, including the Mississippi River Commission and the Office of the Chief of Engineers. Following this, the Chief of Engineers would then include funds in his budget requests for design and construction of those approved plan features that had been previously authorized. For those plan features not previously authorized, review and comment would be sought from the Governor of Louisiana and interested Federal agencies. At the same time, the final EIS would be filed with the US EPA.

After state and interagency review, the final report of the Chief of Engineers would be forwarded by the Secretary of the Army to the US Congress, subsequent to his seeking comments of the Office of Management and Budget regarding the relationship of the project to the programs of the President of the United States. Congressional authorization of the features not previously authorized would then be required.

If the features are authorized, the Chief of Engineers would include funds in his budget requests for design and construction of these features. The New Orleans District will seek expeditious review and approval of the nonauthorized features. However, action on features currently mandated by the US Congress will not be delayed while that authorization is pending.

Advance engineering and design studies would then be initiated, project formulation reviewed, and the plan reaffirmed or modified to meet conditions at that time.

Surveys, materials investigations, and preparation of design criteria, plans, specifications, and an engineering estimate of cost would next be accomplished by the District Engineer. Subsequently, bids for construction of project features would be received and contracts awarded for execution of the work.

THE REPORT

In the interest of clarity and ease of understanding, results of the study effort to date are summarized in this main report and detailed in its appendixes.

The main report is a nontechnical presentation of the overall study, including identification of the study area and its problems and needs, the formulation of plans to resolve the problems and to meet the needs, assessment and evaluation of those plans, and the study recommendations. As the primary document for review, the main report and the EIS are bound together.

Except for recommendations for plan implementation, the appendixes to this report generally contain the same information as the main report, but in significantly greater technical detail. Appendix A provides detailed information about area resources and economy, including the physical and biological resources that constitute the environmental setting, as well as the unique culture and characteristics of the people who inhabit the area. Information is also included on development occurring in the area; the existing plans and improvements; future without-project conditions; water and land resources problems, needs, and opportunities; planning constraints; and specific planning goals and objectives. Appendix B presents a discussion of the formulation of comprehensive multipurpose flood control and resource management plans, impact assessment, and evaluation. Appendix C contains the general criteria used in the design of project features, estimation of costs, analysis of performance, and a statement of specific engineering field and office studies performed. Appendix D presents study economics, including details of the economic benefits and costs of the alternatives accompanied by explanatory rationale. Appendix E presents the social components of the areas under study and their significance, as well as the area's cultural resources. Appendix F contains a detailed analysis of regional recreation, initial and future development needed to supplement existing facilities, and the corresponding administrative responsibilities. Fish and wildlife and related data are contained in Appendix G. Appendix H includes an assessment of endangered species. The Coordination Act report by the US FWS is contained in Appendix I. Appendix J, presents information on the public involvement program used in this study and displays pertinent correspondence with US Army Corps of Engineers response to comments, issues, points of information, and other considerations resulting from the review process, particularly those resulting from the public review of the draft report and EIS.

PROBLEM IDENTIFICATION

The following paragraphs present a discussion of the objectives of national economic development and environmental quality; define the geographic area involved; describe the existing water and land uses, as well as the area's environmental, cultural, social, and economic characteristics; project future conditions in the absence of Federal action; present problems, needs, and opportunities; and translate all of the above into specific objectives to be used as a guide for plan formulation.

National Objectives

The Water Resources Council "Principles and Standards for Planning Water and Related Land Resources" require that Federal and Federally-assisted water and related land planning be directed to achieve national economic development and environmental quality as equal national objectives. National economic development is achieved by increasing the value of the nation's output of goods and services and improving national economic efficiency. Environmental quality, on the other hand, is achieved by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

These national objectives are interpreted as being consistent with and reflective of the concept of total environment set forth in the National Environmental Policy Act of 1969. As a result, planning efforts in this study comprised a broad range of concerns, including those related to the natural, cultural, and human environments and were, simultaneously, responsive to the substantive requirements of NEPA. The national economic development and environmental quality objectives were kept in the forefront throughout the planning process.

Existing Conditions (Profile)

As previously indicated, the study area is comprised of three major interrelated areas: the Red River backwater area; the Atchafalaya Basin Floodway system; and the Atchafalaya Bay complex, including the Lower Atchafalaya River, the coastal marsh and bays, and the backwater area east and northeast of Morgan City.

The northernmost portion of the study area, the Red River backwater area, is located north of Old River and is subject to overflow some 40 miles westward by backwater. This area extends from the proximity of Old River, at the head of the Atchafalaya Basin Floodway system, northward to the vicinity of Monroe, Louisiana. The backwater area is now protected from headwater flooding by the west bank Mississippi River levee, the east bank Ouachita River levee and, to a minor extent, by the Red River levees below Moncla, Louisiana.

The Atchafalaya Basin comprises the central and southern portion of the study area. It is bounded by alluvial ridges that mark the positions of ancient meander belts of Mississippi River courses and extends from the latitude of Lower Old River and Bayou des Glaises to the Atchafalaya Bay and Gulf of Mexico. The basin contains the Atchafalaya Basin Floodway system, which is leveed to form the West Atchafalaya, Morganza, and Lower Atchafalaya Basin Floodways (Plate 1), and encompasses approximately 822,000 acres. Also, within the Atchafalaya Basin Floodway system, the Atchafalaya River is leveed from Simmesport to below Krotz Springs, Louisiana. Below the river levees, the floodway is a wetland of national significance. At the lower end of the Lower Atchafalaya Basin Floodway, waters pass to the gulf through the Lower Atchafalaya River and Wax Lake Outlet. The Atchafalaya Bay complex includes the Lower Atchafalaya River and the backwater area located along the east side of the Lower Atchafalaya Basin Floodway, extending from just below Baton Rouge to the gulf via the Terrebonne Parish marshes and Atchafalaya Bay.

EXISTING AND AUTHORIZED PROJECT FEATURES

Any discussion of the existing plans and improvements associated with the Atchafalaya Basin Floodway project must begin with the Flood Control Act of 1928, as amended. This act authorized the comprehensive MR&T flood control project to provide flood protection in the alluvial valley of the Mississippi River between Cape Girardeau, Missouri, and Head of Passes, Louisiana. Presently, the MR&T project includes a combination of features: levees along the main stem of the river and its tributaries in the alluvial plain to confine floodflows; reservoirs on the tributaries to store excess floodflows; floodways; and improvements to increase channel capacity, such as revetting, diking, and dredging. Other features include control structures, cutoffs, pumping plants, floodwalls, and floodgates. These features are designed to convey the project design flood discharges as was shown on Figure 1.

As was discussed in the Introduction, the principal role of the Atchafalaya Basin Floodway system in the MR&T design is to carry 1,500,000 cfs during a project design flood. An inventory of

currently authorized or existing features in the Atchafalaya Basin and a description of the features follows (see Plate 1).

Old River Complex. The Old River complex consists of a low sill structure which is operated to pass normal and floodflows into the floodways, an overbank structure to pass excess floodflows, and a lock to permit navigation from the Mississippi River to the Atchafalaya River. Present combined flood capacity at the complex is 850,000 cfs (design flows are 620,000 cfs). An auxiliary structure is being constructed to provide a backup system for the low sill structure, which has been damaged and is not capable of functioning as originally designed. Flows through the complex are managed to the extent possible so that 30 percent of the total latitude flow at Old River from the Mississippi River system and Red River system passes through the Atchafalaya Basin on an annual basis.

Morganza Floodway. The Morganza Floodway is the east side artificial intake for the Atchafalaya Basin Floodway, comprising an area of 68,000 acres. It is used only to pass floodflows and has been operated only once, in 1973. The design capacity of the Morganza control structure and floodway is 600,000 cfs.

Atchafalaya River. The Atchafalaya River is the largest distributary of the Mississippi River and is the only natural intake of the Lower Atchafalaya Basin Floodway. The Atchafalaya River extends 141 miles from its source at a junction with Old River to Atchafalaya Bay. The Lower Atchafalaya Floodway is comprised of an upper leveed section, a middle unleveed section, and a lower outlet section. The intake capacity of the Atchafalaya River presently exceeds 700,000 cfs. The design capacity of the combined outlets for the floodway is 1,500,000 cfs; however, their current total capacity is only about 850,000 cfs. Through approximately the upper half of the floodway, the Atchafalaya River is confined between levees. These levees protect the lands of the Morganza and West Atchafalaya Floodways when these floodways are not in operation. On the west bank, the towns of Simmesport, Melville, and Krotz Springs are protected on the floodway side of the perimeter levees by ring levees that tie to the river levees. Any improvements to the Atchafalaya River, including the outlet through the Lower Atchafalaya River or Wax Lake Outlet, necessary to pass design floodflows are considered to be authorized.

West Atchafalaya Floodway. The West Atchafalaya Floodway (the west side artificial intake for the Lower Atchafalaya Basin Floodway) comprises an area of about 170,000 acres. This intake is bounded on the north by the Bayou des Glaises fuseplug levee, on the west by the West Atchafalaya Basin Protection Levee, and on the east by the West Bank Atchafalaya River Levee. The lower limit of the West Atchafalaya Floodway is approximately at the latitude of Krotz Springs. The design capacity of the West Atchafalaya Floodway is 250,000 cfs above Bayou Current and 400,000 cfs below Bayou Current. This floodway is

used only for the passage of floodflows. To date, the floodway has never been operated.

Lower Atchafalaya Basin Floodway. The Lower Atchafalaya Basin Floodway extends from about the latitude of Krotz Springs to the approximate latitude of Morgan City. It is bounded on the east by the East Atchafalaya Basin Protection Levee and on the west by the West Atchafalaya Basin Protection Levee, an area averaging 14 miles wide by 65 miles long. The West Atchafalaya Basin Protection Levee originates near Hamburg, Louisiana, at a junction with the Bayou des Glaises fuseplug levee and proceeds in a southerly direction, terminating south of Berwick, Louisiana. The Morganza Floodway lower guide levee, which continues as the East Atchafalaya Basin Protection Levee, begins at Morganza and proceeds generally southward through Morgan City and along the Lower Atchafalaya River to Avoca Island Cutoff. Any improvements to the protection levees are considered to be authorized.

Flowage Easements. Any form of land-use controls in addition to those described as follows would require congressional approval.

- Below Krotz Springs. The Flood Control Act of 15 May 1928, as amended by the Flood Control Act of 28 June 1938, authorized the Chief of Engineers to purchase flowage easements over all lands below the latitude of Krotz Springs that were not considered subject to frequent overflow as of 1928. This has been established at approximately 68,000 acres. As determined by the Chief of Engineers, only those lands on which the title was clear (and the owner had presented a claim and was agreeable to the appraised value) were subject to the payment of flowage easements. Condemnation was not authorized. Due to the costliness of this process, acquisition of tracts in this category has been on a case-by-case basis. To date, easements have been purchased on approximately 9,000 acres.

- West Atchafalaya Floodway. Perpetual flowage easements on approximately 154,347 acres were acquired by the Government over all lands and improvements in the floodway down to the latitude of Krotz Springs. These easements provide for full use of the lands for flood control purposes. Owners retain the rights to farm, improve, build houses and inhabit the lands, and to harvest timber and minerals.

- Morganza Floodway. Comprehensive easements on approximately 71,577 acres of land within the floodway have been acquired for the passage of floodwaters into the Atchafalaya Basin. Construction for permanent habitation within the flooway is not permitted, but use of the land for farming, removal of timber and minerals, and other purposes not in conflict with flood control is permitted with prior approval.

• Upper Pointe Coupee Area. Inundation rights have been acquired on 12,801 acres of land above the Pointe Coupee drainage structure for storage of runoff when it becomes necessary to close the gates in the upper guide levee during operation of the Morganza Floodway.

• Morgan City Front. Flowage easements have been acquired on 18 acres in connection with the Morgan City front levee.

• Bayou des Glaises Loop. Flowage easements have been acquired on approximately 16,091 acres within the Bayou des Glaises loop.

• Bayou Chene. Flowage easements have been acquired on 692 acres.

NATURAL SETTING, RESOURCES, DEVELOPMENT AND ECONOMY

Prior discussion has described the authority for this study and the flood control aspects of the Atchafalaya Basin. However, the complexity of the problems facing the water resource planner cannot be appreciated without an understanding of the basin environs. As a major distributary of the Mississippi River in early geologic stages of development, the Atchafalaya River and the basin are in a dynamic state of change. In the upper reaches (primarily above I-10), the floodplain has already filled in with sediments and has succeeded to vegetation types that are normally found on infrequently flooded land. The higher ground within the floodway is being developed for intensified agricultural practices.

Contributing to this "drying out" of the upper basin is the fact that as overbank flows become more confined by natural levees formed by the sedimentation process, more scouring occurs in the main channel, thereby increasing cross-sectional area and reducing the river flowline. The lower part of the basin floodway is also changing from a primarily wet environment to a drier one. Lakes are filling in and vegetation changes are occurring. Sediment not deposited in the floodway is passed through either the Lower Atchafalaya River or Wax Lake Outlet and into Atchafalaya Bay where the delta is emerging and new marsh is being formed.

Although the basin is in a dynamic state of change, it remains one of the largest river overflow swamps in the continental United States and harbors a vast array of fish and wildlife resources. The high aquatic productivity of the lower floodway is directly attributable to the annual cycle of flooding and dewatering. Predominant habitat types are early and late successional bottomland hardwood forests, cypress-tupelo swamps, marshland, and cultivated farmland (see Plates 2-4). Marshes extending from the lower floodway

to the gulf grade from freshwater to brackish, to saline in character. Terrestrial and aquatic habitat types are summarized in Tables 1 and 2, respectively. All areas of the lower floodway and surrounding lands are used intensively for hunting, fishing (both commercial and recreational), camping, and general water and wilderness outdoor recreation. Organized hunting camps in the area prevent public access to most privately-owned land. Of the approximate 595,000 acres in the Lower Atchafalaya Basin Floodway, about 445,000 acres are in private ownership, with the other 150,000 acres owned by the State of Louisiana.

Timber harvesting, commercial fishing (including crawfishing), trapping, and oil and gas exploration are the predominant commercial activities in the area. In fact, 25 percent of the commercial forests and 51 percent of the bottomland hardwood forests of the state are located in this general area. The oil and gas industry in the area is thriving and accounts for a significant share of employment in the area, either directly or indirectly. Table 3 depicts value and pounds of fish and shellfish taken in recent years, while Figures 3 and 4 show relevancy of minerals and timber in the study area to statewide production.

The project-affected area has a distinctively rich folk and cultural heritage. Early settlers, the Europeans and French Acadian refugees who came to occupy the area, displaced the indigenous Indian tribes inhabiting the basin. The first white settlements were limited to the periphery of the swamp; however, with the expansion of the plantation system, the French-speaking Acadians soon abandoned agricultural pursuits, principally due to the disastrous effects of flooding and backwater on their crops. Instead, many of these Acadians turned to extractive pursuits of wild resources from the swamp, principally hunting, fishing, trapping, and removal of cypress for building materials and commerce. The basin culture did not develop in isolation, but adjusted through time to new technology and demands. At present, the heart of the swamps has largely been abandoned and most inhabitants have moved to the edges of the Lower Atchafalaya Basin Floodway. This abandonment was due to the loss of wetlands caused by levee construction and sedimentation, discovery of oil and gas in the basin, and the technological advances and conveniences of the 20th century. However, there remains today an abundance of folk behavior and tradition adapted to swamp utilization which comprises an "Atchafalaya Basin Culture." The rich cultural heritage of the project-affected area offers great scientific, educational, and interpretative potential.

TABLE 1

EXISTING TERRESTRIAL HABITAT

Habitat Type	1975 Acreage				1980 Acreage	
	Red River Backwater Area	West Atchafalaya Floodway	Simmesport, Melville, and Krotz Springs	Morganza Floodway	Lower Atchafalaya Basin Floodway 1/	Areas Outside the Floodway System 2/
Mid-to-Late Successional Bottomland Hardwood Forest	391,000	108,000		39,000	247,000	85,000
Cypress-Tupelo Swamp	29,000			1,000	176,000	275,000
Early Successional Bottomland Hardwood Forest					91,200	2,700
Early Successional Bottomland Hardwood Forest Mixed with Cypress-Tupelo					8,400	
Cleared Land	354,000	60,000		17,000	16,400	80,800
Fresh Marsh						323,000
Brackish Marsh						89,400
Saline Marsh						108,000
Urban	1,000		2,000			5,300
Active Delta						10,100
TOTAL	775,000	168,000	2,000	57,000	539,000	979,300

1/Includes the area bounded by a line one-quarter mile west of the West Atchafalaya Basin Protection Levee north of Verdunville and a line one-quarter mile east of the East Atchafalaya Basin Protection Levee north of Bayou Sorrel.

2/Includes all lands outside the protection levees south of Verdunville on the west side and the Lower Atchafalaya River backwater complex.

TABLE 2

EXISTING AQUATIC HABITAT

Habitat Type	1975 Acreage				1980 Acreage	
	Red River Backwater Area	West Atchafalaya Floodway	Simmesport, Melville, and Krotz Springs	Morganza Floodway	Lower Atchafalaya Basin Floodway [1]	Areas Outside the Floodway System [2]
Riverine, Distributary, or Open-Ended Canal	27,000				23,000	8,000
Freshwater Bayou or Slow-Flowing Canal	12,000	1,000			15,900	22,100
Headwater Lake					18,200	
Backwater Lake	36,000	1,000			13,800	28,200
Cropland Lake	6,000	500				
Fresh Marsh Pond and Lake						87,600
Fresh Bay						200,000
Brackish Marsh Pond and Lake						55,200
Brackish Bayou or Canal						6,200
Brackish Bay						58,900
Saline Marsh Pond or Lake						64,400
Saline Bayou or Canal						6,100
Saline Bay						53,800
Shallow Gulf						804,000
TOTAL	81,000	2,500			70,900	1,394,600

[1] Includes the area bounded by a line one-quarter mile west of the West Atchafalaya Basin Protection Levee north of Verdunville and a line one-quarter mile east of the East Atchafalaya Basin Protection Levee north of the Bayou Sorrel.

[2] Includes all lands outside the protection levees south of Verdunville on the west side and the Lower Atchafalaya River backwater complex.

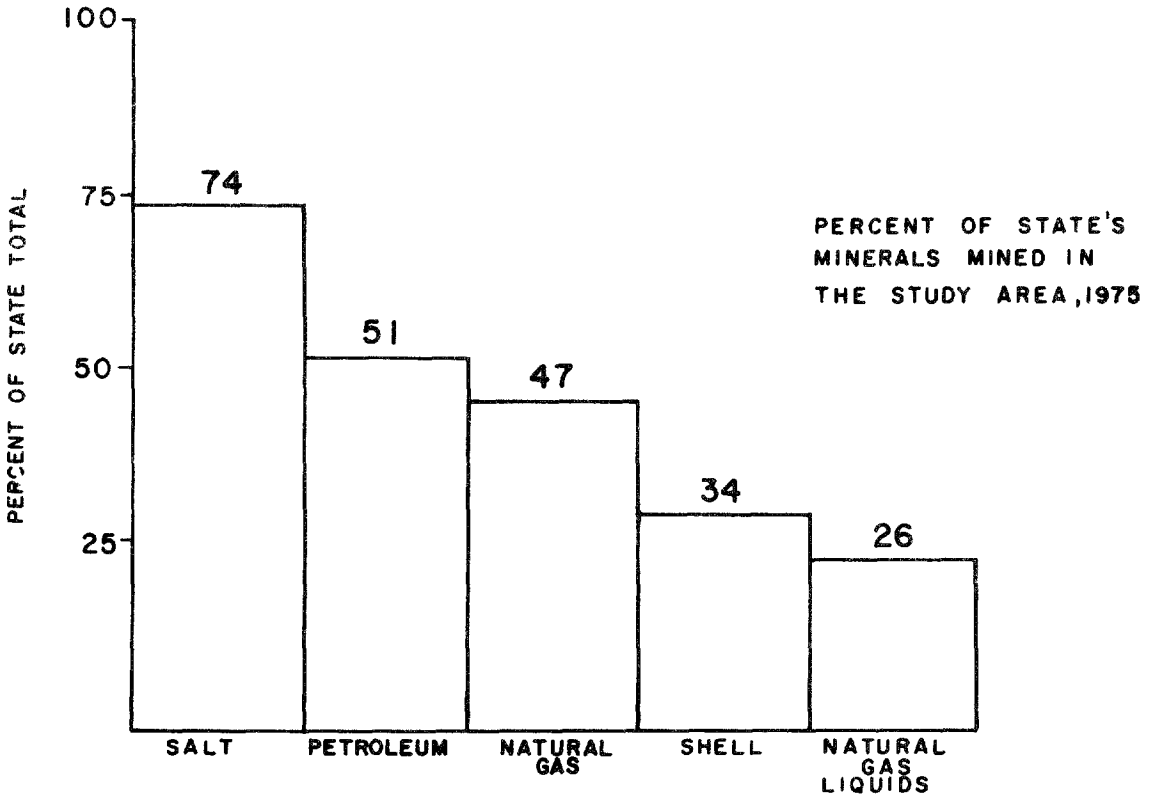
TABLE 3

POUNDS AND VALUE OF FISH AND SHELLFISH FOR THE ATCHAFALAYA BASIN [1/]

Species	1976		1977		1978		1979	
	Pounds	Value ($)	Pounds	Value ($)	Pounds	Value ($)	Pounds	Value ($)
Bowfin	13,200	945	11,500	1,014	3,700	356	13,600	1,406
Buffalo	726,900	108,587	836,200	129,733	1,365,700	231,959	2,055,400	353,113
Carp	105,100	4,272	59,800	2,959	61,500	3,235	131,800	10,128
Catfish	644,600	225,585	631,900	228,216	660,400	270,170	613,600	255,509
Garfish	75,900	11,029	93,700	15,996	130,500	25,375	158,500	34,280
Paddlefish	3,100	249	2,700	254	14,900	1,759	30,600	3,349
Gou	354,300	52,582	345,500	52,448	203,900	32,307	527,600	87,068
Shad	573,100	21,735	654,600	31,039	413,100	25,644	474,100	48,343
Crawfish	5,620,100	1,692,063	1,310,900	708,413	13,941,700	4,107,092	5,524,500	1,981,940
FW Turtle	9,100	4,013	6,900	3,247	13,400	5,016	29,900	16,249
Frog	25,000	19,075	21,000	19,969	33,500	47,492	15,400	15,166
River Shrimp	2,500	1,750	2,000	1,392	4,800	3,663	8,500	6,376
Total	8,150,650	2,141,885	3,976,700	1,194,680	16,847,100	4,769,988	9,583,500	2,812,927

[1/] Preliminary, subject to revision.

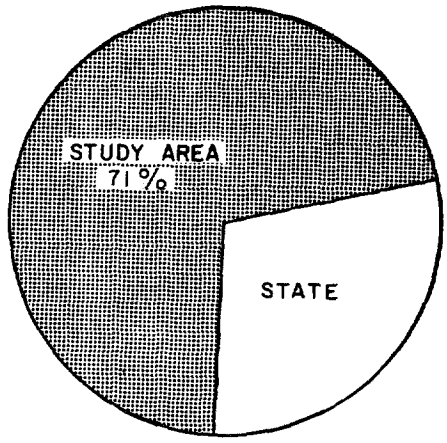
Source: National Marine Fisheries Service as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin," F. W. Bell, 1980.



SOURCE : U.S. DEPT. OF THE INTERIOR, BUREAU OF MINES, "THE MINERAL INDUSTRY OF LOUISIANA 1975", AND UNPUBLISHED DATA.

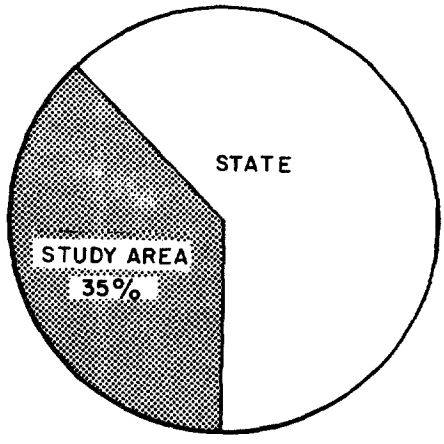
FIGURE 3 MINERALS

CYPRESS



71 PERCENT OF CYPRESS TIMBER SEVERED IN THE STATE IS IN STUDY AREA, 1977

HARDWOODS



35 PERCENT OF HARDWOOD TIMBER SEVERED IN THE STATE COMES FROM STUDY AREA, 1977

SOURCE: LOUISIANA DEPT. OF NATURAL RESOURCES, OFFICE OF FORESTRY "TIMBER AND PULPWOOD PRODUCTION IN LOUISIANA", APRIL 1978.

FIGURE 4 CYPRESS AND HARDWOODS

Conditions If No Federal Action Taken (Without Condition Profile)

Because of the devastating effects that would result from not controlling flows from the Mississippi River into the Atchafalaya Basin at the Old River control complex and from not providing flood overflow restraint with the basin protection levees, there is no true no-action alternative for this study. The future without-project conditions described below assume continuing a 70/30-percent distribution of flow below the Old River control structure, with 30 percent regulated to the Atchafalaya River, and the continued development and maintenance of the basin protection levees to project flood levels by local interests.

NATURAL SETTING, RESOURCES, DEVELOPMENT AND ECONOMY

The process of a river overflowing its banks and depositing sediments on adjacent land areas is a natural developing process of a young river like the Atchafalaya. Each year when the river conveys spring floods to the gulf, it overflows its banks and deposits sediments. These sediments build natural levees in the overbank areas that become flooded. As the natural levees along the water channels within the Lower Atchafalaya Basin Floodway build up to higher elevations from the yearly overflows, the quantity of water diverted to the overbank areas will gradually decrease; therefore, the quantity of sediments deposited or rate of sediment deposition on the overbank areas is expected to decrease accordingly. While significant amounts of deposition have already taken place throughout most areas of the floodway, additional sediment deposits of up to 9 feet deep could occur in some locations.

Sediment that passes through the Lower Atchafalaya Basin Floodway to the Atchafalaya Bay will continue to build the delta. It is expected that about 300 square miles of land will emerge as a result of this active deltaic process. If no actions are taken to control flows through the Lower Atchafalaya River and Wax Lake Outlet, the outlet will capture a larger share of the flow conveyed to the gulf. As the natural levees of the main channel in the Lower Atchafalaya Basin Floodway are built up, a larger percentage of the river flow will be confined to the channel, which will result in its continued natural enlargement between 1980 and 2030. The channel's cross-sectional area between mile 54.8 and 65.4 is projected to increase from 92,000 sf to about 110,000 sf. Between mile 65.4 and mile 100.8, the channel's cross section will increase from about 80,000 to 98,000 sf. Channel enlargement above river mile 55 is expected to be minimal, increasing from 118,000 sf in 1980 to only about 121,000 sf by the year 2030.

The shift in distribution of flows through the outlets toward a larger part of the total flow being conveyed by Wax Lake Outlet will have the net effect of a loss in total flow capacity of the outlets as existed in 1980. This, along with the projected overbank sediment deposition, will cause the project flood flowline to become higher than if some alternate action were taken. The no-action flowline is projected to be up to 1.5 feet higher than the 1973 refined flowline, the current project design flowline. This higher flowline effect would extend along the East Atchafalaya Basin Protection Levee, West Atchafalaya Basin Protection Levee, Morganza Floodway levees, and the Atchafalaya River levees.

While the average stage hydrographs for the no-action alternative would be lower than the present hydrographs, they would be higher than the hydrographs resulting from alternative actions. The differences in magnitude are generally between 1 and 2 feet higher for all areas of the lower floodway.

As deltaic development in the Atchafalaya Bay continues, the Atchafalaya River's mouth will continue to move gulfward, and stages at the end of the east protection levee at Avoca Island Cutoff for a given flow will continue to rise. It is the stage at the end of this levee that governs the amount of backwater flooding that reaches the area east and northeast of Morgan City. For this reason, the backwater flooding problem in this area will continue to worsen with the no-action plan. The water level or stage at Amelia, with an average return interval of 100 years, is expected to rise from 5.5 feet to 7.9 feet. Similar increases in stage heights are expected to occur throughout the backwater area.

The various land and water habitat types in the project area form a complex and ever-changing pattern. This pattern is the result of changes induced by varying water levels and length of time of flooding, sediment deposition in open water and overbank areas, and changes in salinity concentrations in the coastal reaches of the basin. The naturally occurring alluvial riverine processes are further altered by controlling the flow at Old River, clearing land for timber and agriculture, dredging canals, and building levees. The assumed non-Federal action of raising the existing levees, as previously mentioned, would result in environmental impacts. The habitat changes which would be associated with this levee raising are shown in the EIS, Table 6-1. Also, in the EIS, Table 6-7 shows in column 2 the expected acreages of habitat types in the Lower Atchafalaya Basin Floodway, backwater areas, and marsh complex during the next 50 years, if the Federal project is not implemented.

Early successional bottomland hardwood forests would decrease by approximately two-thirds due to the conversion of the existing acreage within the Henderson area to the mid-to-late successional bottomland hardwood category or to the clearing of this acreage

for agriculture. Mid-to-late successional bottomland hardwood forests would decrease by about 50 percent, primarily because of land clearing for agriculture. Cypress-tupelo swamps would decrease only slightly, most of which would be attributable to the conversion of this type to the bottomland hardwood mixed with cypress-tupelo category (see EIS, Table 6-7). This conversion would occur due to sedimentation and a lowering of water levels within the Lower Atchafalaya Basin Floodway. Another factor of far greater importance to the ecology of the basin is the potential harvest of the maturing cypress-tupelo timber. For a worst-case analysis, it was assumed that 50 percent of the acreage existing in 1980 could be cut-over by the year 2030. Additionally, the projected future rise of water levels in the backwater area northeast of Morgan City could have significant adverse impacts upon the forests. Open land acreage in the affected area would increase about three-fold by 2030, almost entirely as a result of the clearing of bottomland hardwood forests for conversion to agriculture and this change would have a profound effect on terrestrial wildlife resources.

Fishery resources changes would be dramatic within the Lower Atchafalaya Basin Floodway and adjacent marshes in the absence of a Federal project. The most significant changes would be caused by the projected conversion of annually flooded forestlands to agricultural lands. Other primary impacts would be a net loss of aquatic habitat due to sedimentation and the creation of new delta. The major significance of aquatic habitat losses would be a reduced harvest of freshwater fish and crawfish. The magnitude of these reductions in harvest of some common species is presented in the EIS, Table 6-10. This table also shows changes in the harvest rates of estuarine-dependent species. These data reflect the deterioration in the marsh-delta complex.

Timber resources would be greatly depleted by the conversion of forests to farmland and, in addition, the harvest of cypress-tupelo forest in some areas could become a permanent loss because altered flooding cycles could prevent regeneration of these trees. A general decline in overall water quality is expected to occur within the floodway during the next 50 years, a result of reduced water levels and decreased circulation in backwater areas. Decreased biological productivity would accompany the eventual shortage of nutrients and oxygen. Further physical modifications, including canal dredging and dredged material deposition by private interests, would reinforce these trends. The changing conditions would favor agricultural, industrial, and urban developments, along with their attendant pollution potentials. The continuing sedimentation and draining of the swamps would also adversely impact the swamp-dependent part of the economic base, and thus, the lifestyle of the people who live along the edges of the floodway.

The most significant agricultural development in the area during the next several decades under the future without-project condition

will be conversion of forestland to agricultural production. In the Lower Atchafalaya Basin Floodway, conversion of about 200,000 acres of forestland to agricultural land is expected to occur. Aside from the significant boost in agriculture-related goods and services that this land-use conversion would provide, the major impacts will be a reduction in both forestry activities and recreational opportunities on the converted land. No long term mineral projections specific to the Atchafalaya Basin are available. This area is important in the production of oil and natural gas and this is expected to continue in the future.

Problems, Needs, and Opportunities

The overriding factor in any analysis of the Atchafalaya Basin is the requirement of the basin to function properly and adequately during major flood events. All other aspects of plan formulation must be subservient to this goal. Other needs include protection or enhancement of environmental features, provision of public recreation opportunities and maximizing delta development. Environmental groups have promulgated the concept of a "wet and wild" Atchafalaya Basin. But it is not possible to halt the natural changes that are occurring in the basin. It is desirable, however, to manage these changes to provide the best possible environmental conditions.

As stated previously, the Atchafalaya Basin Floodway system must be capable of passing 1,500,000 cfs during a project design flood. The lower floodway cannot currently meet this criteria, primarily because of sediment deposition in the overbank areas. This capacity is being restored by raising the East and West Atchafalaya Basin Protection Levees. Also, the outlets are not capable of passing design flows. This problem is a result of reduced flow capacity of the Lower Atchafalaya River (Morgan City to the gulf) as a result of a natural delta-building process and the fact that the Wax Lake Outlet has been capturing more and more of the low to normal flows, generating a channel degradation problem on the Lower Atchafalaya River.

The low sill structure at Old River is not capable of withstanding design head differentials. This deficiency is a result of bed scouring during recent flood events which have undermined the structure. The design capability of this structure must be restored because as the Atchafalaya River develops, the head differentials at Old River will increase and because this structure is used to control flow into the area on a daily basis. It is imperative that a reliable method of controlling normal flows, as well as floodflows, be available.

Backwater flooding in the area east and northeast of Morgan City is increasing, both in frequency and intensity, because the delta development and decreasing channel capacity along the Lower Atchafalaya River are resulting in a rising flowline along the lower river.

The major threat to the natural environment of the area is land clearing for agricultural development. As sediment has been deposited in the basin (especially in the Lower Atchafalaya Basin Floodway above I-10) and as the main channel has degraded and lowered flowlines, some areas are now suitable for conversion from timberland to agriculture. Even with the threat of periodic flooding, agricultural practices return far more profit per acre than timber. The primary crop raised in the basin is soybeans. As the floodway in the area below I-10 becomes higher and drier, it will be subject to the same land-use conversion pressures as the lands above I-10.

A common cause of physical changes occurring in the lower floodway is sediment. If the introduction of sediment into the basin could be stopped, then changes in the area would be minimized. Of course, this is not possible. Practically speaking then, sediment management is the primary consideration for influencing physical changes in the basin. It must be realized, however, that no action can be taken which would impede the freshwater flows into the backswamp areas of the basin. These flows are vital to the entire ecosystem of the area. It is important to realize also, that a large portion of the total sedimentation in the basin is delivered during floods when the water is levee to levee. During these times, no sediment management measures can be effective. Thus, the need to influence sediment deposition can be realistically pursued only for low to normal flow conditions.

Land-use controls in the lower floodway for both flood control and environmental purposes need to be reevaluated. Concern has been expressed by some that public access needs to be expanded. Currently, that area of the floodway is intensively utilized for hunting, fishing, etc., but most of the area is privately-owned and leased by club organizations. Also, there is high potential for additional recreation facilities, such as campgrounds, boat-launching ramps, scenic areas, and hiking trails. The State of Louisiana is on record as supporting the need for additional public access. As parts of the floodway system become less susceptible to flooding, residential, agricultural and industrial development, if uncontrolled, can be expected to occur. If this is allowed, then some have speculated that there will be a reluctance to use the system for the passage of floodflows and a high degree of environmental degradation would occur. Also, if the floodway becomes developed, then substantial damages would be sustained with each usage.

Planning Goals and Objectives

Aside from the co-equal national objectives of environmental quality and national economic development, goals and objectives specific to the Atchafalaya Basin study were defined by the Agency Management Group. The primary goal is to develop, as soon as possible, an implementable, multipurpose plan to protect south Louisiana from MR&T floods while retaining and restoring the unique environmental features and long-term productivity of the natural environment of the basin.

Within this overall goal, specific objectives can be defined. Among these are:

- Flood Control - Implement a flood control system that will safely pass the project flood to the Gulf of Mexico in an environmentally sound manner. Reduce to the maximum extent practical the deposition of sediments that reduce the ability of the floodway to pass the project flood.

- Natural Environment - Retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands.

- Agricultural Activities and Mineral Development - Allow agricultural activities and mineral developments, provided such activities do not interfere with the goals relative to flood control or the natural environment.

- Delta Formation - Maximize natural delta formation in Atchafalaya Bay while providing for navigation and passage of the project flood.

- Public Accessibility - Maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway.

PLAN FORMULATION

The planning process used in this study consisted of first developing groups of measures to address the individual functional and geographical areas of concern and then combining alternative features for those measures into comprehensive plans. Initially, eight groups of measures, which generated 45 separate alternative features, were defined. These alternative features were grouped into 10 plans for presentation at the formulation-stage public meetings held in Louisiana during January 1979. Subsequent to those meetings, many of the features were eliminated while a limited number of new alternatives were added. These remaining alternatives were then grouped into plans which, through a series of iterations, were reduced to the Recommended Plan (Appendix B should be consulted for a detailed description of the plan formulation process used to arrive at the Recommended Plan). Descriptions of those alternative features considered in developing the detailed plans follow.

Alternative Features

GROUP I - ALTERNATIVES FOR OPERATION OF OLD RIVER CONTROL STRUCTURE

Maintain a 70/30-percent annual distribution of total flows between the Mississippi and Atchafalaya Rivers below Old River, respectively (current operation). This alternative provides for operation of the Old River control structure to maintain the approximate 1950 distribution of flows between the Mississippi and Atchafalaya Rivers. This flow distribution is normally regulated on a daily basis. Various interest groups expressed a desire for this distribution to be modified slightly. For example, farmers in the Red River backwater area would benefit during some years in the months of May, June, and July from a reduction of flow into the Atchafalaya River so that stages would not interfere with crop planting. However, the US FWS would like flows increased during the same months in some drier years to benefit fishery resources in the lower floodway. Actually, these seemingly incompatible desires would not conflict during some years. Short term changes in flow distribution might be feasible when such changes could be accomplished without adversely impacting other resource uses. Operational procedures would be reviewed to determine the advisability of developing specific criteria for such changes.

GROUP II - ALTERNATIVES FOR ATCHAFALAYA BASIN MAIN CHANNEL DEVELOPMENT AND LEVEE RAISING

All alternative features for main channel development recognize that the East and West Atchafalaya Basin Protection Levees will continue to be raised, as necessary, in combination with the main channel development feature to safely pass the project flood. Also included in all structural plans is the installation of bank protection measures on the Atchafalaya River above river mile 55.0. Main channel features considered in detail follow.

- Channel training would be accomplished by dredging material from the main channel where necessary and depositing it within diked areas on the banks to a height sufficient to contain the average annual high water.

- The main channel would be dredged as necessary to attain a 100,000-sf cross-sectional area from the head of Whiskey Bay pilot channel to Wax Lake Outlet, and to an 80,000-sf cross-sectional area from Wax Lake Outlet to Stouts Pass. Gaps would be left in the dredged material. In a modification of this alternative feature, no gaps would be left in the dredged material.

GROUP III - ALTERNATIVES FOR SEDIMENT CONTROL

Entrance channels of principal main channel distributaries would be realigned so that flows would remain essentially as they are now but would be as sediment-free as possible.

GROUP IV - MANAGEMENT UNITS AND RELATED FEATURES

Natural processes and human actions have combined to produce distinct environmental and hydrological subdivisions within the Lower Atchafalaya Basin Floodway. These areas have been identified as management units for the purpose of formulating individual water management plans to retain or restore unique environmental values of an individual area (see Figure 5). Management units should be designed so that:

- Water regimes are restored as closely as practicable to historical overflow patterns.

- Proper water movement occurs through the units.

- Sediment movement and deposition in the units are restricted.

- Nutrients and organic matter are supplied to the estuarine area and the Gulf of Mexico.

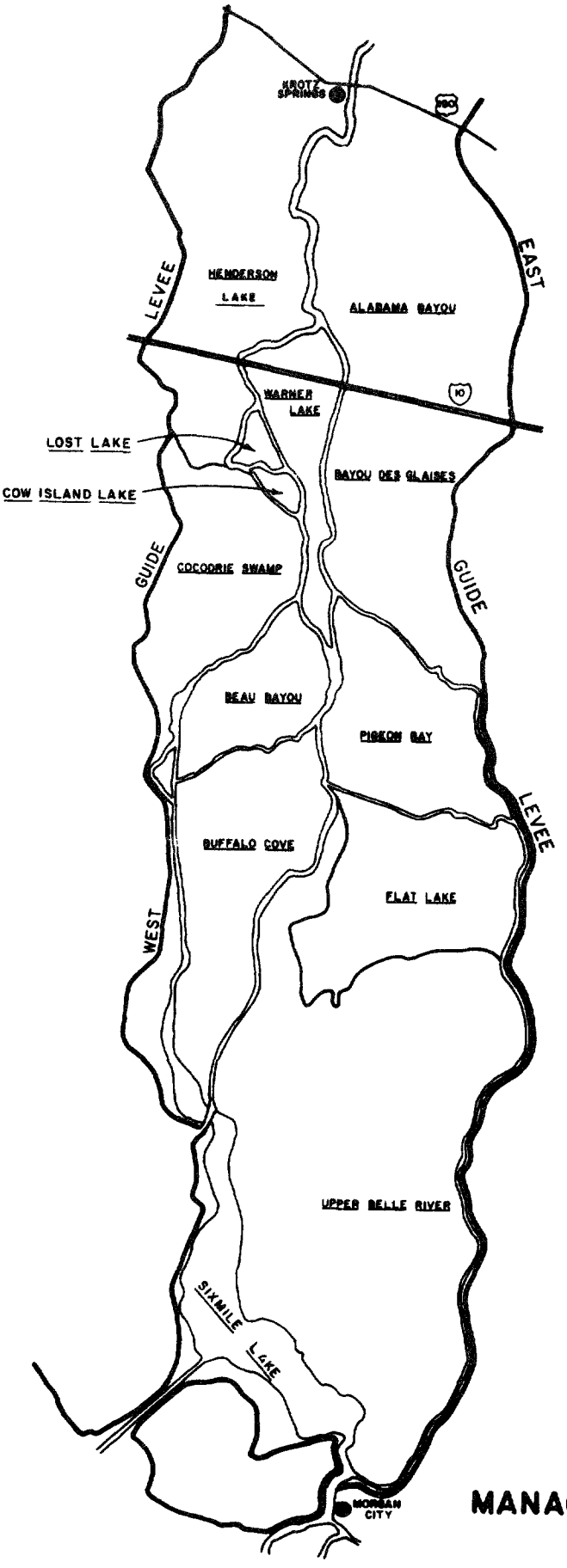


FIGURE 5

MANAGEMENT UNITS

Each management unit would be individually evaluated to determine its potential effectiveness for retaining or restoring desirable environmental values. Conceptually, improvements necessary to create management units consist of dredging entrance channels, constructing some low levees or dikes around prospective units, and installing weirs in the inlet and outlet channels to control flows.

In addition to management units, gated diversion structures would be provided for the Henderson Lake and Alabama Bayou area to introduce up to 3,000 cfs of freshwater through the Atchafalaya River levees. Other improvements could be achieved by selective closing of canals that allow sediment-laden waters to reach backswamp areas, and selective opening of dredged material banks to improve water flow patterns.

GROUP V - ALTERNATIVES FOR FLOODWAY LAND USE

The following proposed real estate interests were considered. In addition to the interests cited, several combinations of the individual features were considered.

- No Action. No additional real estate interests would be acquired.

- Fee Acquisition. The Federal Government would purchase all surface rights to all lands in private ownership in the Lower Atchafalaya Basin Floodway below the approximate latitude of Krotz Springs, Louisiana.

- Comprehensive Multipurpose Easement: Government Controls Timber and Access. This easement would allow the Federal Government to overflow lands in the Lower Atchafalaya Basin Floodway for any purpose for any length of time, either naturally or artificially; to construct recreational facilities; to regulate public access; to forbid construction of permanently habitable structures; to forbid or regulate the construction of other structures, including camps; to forbid removal of timber; to forbid the use of lands for agricultural purposes; and to regulate excavation and landfill operations. Landowners would retain mineral rights. These easements would be acquired over all lands in private ownership within the Lower Atchafalaya Basin Floodway below the approximate latitude of Krotz Springs.

- Comprehensive Easement: Landowner Controls Timber, Government Controls Access. This interest would be similar to the preceding alternative, except the landowner could pursue good commercial timber practice on a sustained yield basis.

- Comprehensive Easement: Landowner Controls Timber and Access. This would be similar to the preceding alternative, except the landowner would also control access.

- Comprehensive Easement: Landowner Controls Access, Government Controls Timber.

- Recreation Features. A concept of potential resource use and allocation was developed, which would minimize overall land acquisition and development yet increase public access within the Lower Atchafalaya Basin Floodway. Included in this conceptual plan were areas having the potential to be used for or classified as wildlife refuges, natural areas, public hunting areas, public fishing and crawfishing areas, nature hiking, canoe trail areas, developed and primitive camping areas, boat-launching areas, and areas having significant and unique resources. A detailed discussion of recreation resources is presented in Appendix F.

GROUP VI - ALTERNATIVES FOR FLOODWAY OUTLETS AND DELTA BUILDING

This group of alternative features was considered in detail to address the problem of conveying floodflows past Morgan City via the Lower Atchafalaya River and through Wax Lake Outlet to the gulf.

- Maintaining existing flow distribution, Lower Atchafalaya River 70 percent/Wax Lake Outlet 30 Percent.

- Maintaining same flow distribution, but with sediment redistribution.

- Reestablishing approved design flow distribution (Lower Atchafalaya River 80 percent/Wax Lake Outlet 20 percent).

- Closing Wax Lake Outlet to normal flows (Lower Atchafalaya River 100 percent/Wax Lake Outlet 0 percent).

- Implementing channel training in Lower Atchafalaya River and Wax Lake Outlet.

- Widening Wax Lake Outlet overbank area.

GROUP VII - ALTERNATIVES TO REDUCE BACKWATER FLOODING EAST OF THE FLOODWAY

Alternatives considered in detail for the backwater flooding problem east and northeast of Morgan City follow.

- Limited Structural Measures. These alternative features for protection of only the developed parts of the backwater area east of the floodway would consist of construction of ring levees and drainage pumping stations. One feature would use two ring levees to protect the Morgan City - Amelia and Bayou Black industrial areas. This option would utilize a navigation

structure in Bayou Chene just below Bayou Boeuf, on Bayou Boeuf just below Lake Palourde, and two on Bayou Black. These structures would be closed when water elevations begin flooding the areas. To provide for drainage of the runoff from the backwater area above Morgan City, a bypass east of and equivalent in size to Bayou Boeuf would be required. A second alternative feature would use 28 ring levees with pumping stations for interior drainage to protect the same industrial areas as well as various other populated areas within the backwater area. Such ring levees would provide protection within the ringed areas from backwater flooding as well as headwater and tidal flooding. However, the construction right-of-way for required ring levee alinements would require the relocation of about 1,900 existing residential, commercial, and public structures that are located along bayous or in other physically restricted areas. Further, all structures located outside the ring levees would require raising, flood-proofing, or removal for prevention of flood damages. Additionally, this alternative would not offer protection for roads nor most existing farmlands that are subject to backwater flooding.

• Extension of Avoca Island levee. With this alternative feature, Avoca Island levee would be incrementally extended to a total length of either 17.0 or 19.6 miles, depending upon the levee alinement selected (Plate 10). The existing Avoca Island levee was constructed to limit project flood stages east of Morgan City to generally the same stages that occurred in that area in the 1945 flood. The amount of flooding from backwater is related to the stage in the Lower Atchafalaya River at the end of the Avoca Island levee. Since the active development of the delta in Atchafalaya Bay will result in elongation of the river's course and thereby raise the stage at the end of the existing levee for a given discharge, flooding caused by backwater in the area east of the floodway will become more frequent and to greater depths as time progresses. Thus, this feature would provide phased implementation of additional levee reaches as necessary to maintain stages for each reach equivalent to the 1945 backwater conditions. Several alinements for the total levee extension were considered. An alinement totaling about 17.0 miles in length immediately adjacent to the east side of the Lower Atchafalaya River would be accompanied by extensions of the Avoca Island Cutoff channel around the end of each reach to provide for navigation. An alinement totaling about 20 miles in length following the marsh adjacent to the shoreline would require some type of navigation structure in the levee, since it would be infeasible to extend the cutoff channel around the end of the levee and across the bay to the Lower Atchafalaya River channel for each reach of the levee extension. Because the marsh in Terrebonne Parish east of the Avoca Island levee depends upon freshwater and sediment from the Lower Atchafalaya

River to prevent saltwater intrusion and help to compensate for marsh subsidence, a freshwater diversion structure or structures would be included in the levee extension to divert flow from the river to the marshes. The structure(s) would be designed to maintain the present distribution of flow, estimated to be 4,000 cfs, into the west Terrebonne Parish marsh and would be closed when the stage at Amelia, Louisiana, reaches 3.0 feet NGVD to provide protection from Lower Atchafalaya River backwater.

- Extension of Avoca Island Levee 14,000 Feet. The Avoca Island levee would be extended by 14,000 feet to continue backwater flooding protection in the area east of the floodway for a period of about 10 years. This would provide an interim period of protection to allow for completion of detailed studies of the Atchafalaya Bay - Terrebonne Parish marsh - backwater complex. A freshwater diversion structure, identical in both design and operation to that described under Extension of Avoca Island Levee, would also be provided for this interim protection feature.

GROUP VIII - MANAGEMENT ENTITY

- To insure the proper implementation and operation of the plan selected, a management entity would be established, composed of the US Army Corps of Engineers, US EPA, US FWS, and the State of Louisiana. Mechanisms would be included for public involvement. The management entity would not inhibit emergency flood control operations by the US Army Corps of Engineers.

- No management entity would be formed.

- Some combination or part of the above feature would be adopted.

Plans of Others

In October 1978, the US FWS published a brochure entitled, "The Atchafalaya, America's Greatest River Swamp." That brochure proposed that approximately 443,000 acres of floodway land between Krotz Springs and Morgan City, excluding developed ridge areas, be acquired by the US Army Corps of Engineers to establish the Atchafalaya Fish, Wildlife, and Multi-Use Area. Mineral rights would be retained by present owners, with exploration and extraction opportunity being essentially the same as now. Timber harvest would be for the primary purpose of optimizing fish and wildlife productivity and natural beauty. The result of this would be a minor reduction in sawtimber

yield as compared to industrial forestry practices. Camps within the floodway, along perimeter levees, would not be affected; however, public access points would be obtained. Other camps within the basin would be retained for life by present owners. Flood control would be under US Army Corps of Engineers jurisdiction; management for fish and wildlife conservation and public use would be the joint responsibility of the Louisiana Department of Wildlife and Fisheries and the US FWS. Commercial crawfishing, fishing, trapping, sport hunting, and general public use would be maximized.

During the planning process the US Army Corps of Engineers developed a real estate concept for the Lower Atchafalaya Basin Floodway based on a categorization of existing uses of the basin's environmental and recreational resources by the various concerned interest groups and the general public. This concept was presented to other Agency Management Group members, and resulted in subsequent real estate proposals by US EPA, US FWS, and the State of Louisiana. Details of the state proposal, which was adopted for the "public access" feature of the Tentatively Selected Plan, are contained in Appendix B.

Development of Detailed Plans

From the features considered in detail, 10 alternative structural plans were developed as shown in Table 4. In this table, alternative Plan 1 reflects present conditions, Plan 2 shows the future without-project conditions, and Plans 3 through 10 are alternative plans that could be implemented. Plans 7 through 10 have been further subdivided to show these plans both with and without management units. Some plans emphasize the environmental quality goal, some the national economic development goal, and some a combination of both co-equal goals. From these plans, the final three plans--National Economic Development, Environmental Quality, and Tentatively Selected--were chosen. Rationale for that selection process is detailed in Appendix B and summarized in subsequent paragraphs of this report.

TABLE 4

ALTERNATIVE STRUCTURAL PLANS

Feature	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7 a / b	Plan 8 a / b	Plan 9 a / b	Plan 10 a / b
Old River Control Structure 70%/30% Mississippi/Atchafalaya	---	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Levee Raising	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Main Channel:										
100,000 Square Feet Dredging (modified)	---	---	---	---	Yes	Yes	---	---	---	---
100,000 Square Feet Dredging	---	---	Yes	---	---	---	---	---	---	---
Channel Training	---	---	---	Yes	---	---	Yes	Yes	Yes	Yes
Sediment Control	---	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes
Management Units	---	---	---	Yes	---	---	No/Yes	No/Yes	No/Yes	No/Yes
Outlets:										
Lower Atchafalaya River/Wax Lake Outlet										
70% / 30%	---	---	---	Yes	---	---	---	---	---	---
100% / 0%	---	---	---	---	Yes	Yes	---	---	---	---
70% / 30% → 80% / 20%	---	---	---	---	---	---	---	---	Yes	Yes
70% / 30% → 80% / 20% → 100% / 0%	---	---	---	---	---	---	Yes	Yes	---	---
80% / 20%	---	---	Yes	---	---	---	---	---	---	---
Increase Sediment to Wax Lake Outlet	---	---	---	Yes	---	---	---	---	---	---
Widen Wax Lake Outlet Overbank	---	---	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Channel Training Below Morgan City	---	---	---	---	Yes	Yes	Yes	Yes	Yes	Yes
Backwater Flooding:										
Extend Avoca Island Levee	---	---	Yes	Yes	Yes	Yes	Yes	---	Yes	---
Limited Structural Measures	---	---	---	---	---	---	---	Yes	---	Yes

Note: To develop complete multi-purpose plans, a real estate option and a management entity alternative should be added to each structural plan. All plans include bank stabilization on the Atchafalaya River above mile 55, recreational developments and minor project features.

ASSESSMENT AND EVALUATION OF FINAL PLANS

Detailed analyses of the alternative plans indicated that certain features were desirable from both an economic and an environmental standpoint or, as in the case of the Avoca Island levee extension, they were the only alternative that fully satisfied one of the project goals. Among those features were sediment control, channel training above Morgan City, and the Avoca Island levee (14,000-foot extension). Accordingly, plans that contained those features (Plans 4, 7, and 9) were considered in the final array while those that did not contain those features (Plans 3, 5, 6, 8, and 10) were eliminated. The three remaining plans were evaluated and from them, the Environmental Quality Plan (Plan 4), the National Economic Development Plan (Plan 7a), and the Tentatively Selected Plan (Plan 9b) were chosen.

Subsequent to the public meeting reviews of the draft plan/EIS in July 1981, the Recommended Plan has been developed from the Tentatively Selected Plan. Further, the National Economic Development and Environmental Quality Plans have been revised to reflect changes resulting from public comments and study data refinement since the public meetings. Draft versions of these plans may be found in Appendix B.

Descriptions of each of the three final revised plans are presented in the following paragraphs. In addition to plan descriptions, significant beneficial and adverse impacts, an evaluation and trade-off analysis, and mitigation requirements are presented. Responsibilities for implementation are also included, along with the apportionment of costs for each detailed plan.

Final Environmental Quality (EQ) Plan

PLAN DESCRIPTION

This plan is comprised of a combination of features that emphasize environmental quality while safely conveying the project flood through the Atchafalaya Basin to the gulf. Its features are as follows:

70/30-Percent Distribution of Flows at Old River. This is the present plan of operation for the Old River control structure, Louisiana, project and would not change. The Old River control structure would be operated so that approximately 30 percent of the combined flows of the Red and Mississippi Rivers above Old River are distributed to the Atchafalaya River, and 70 percent are distributed to the Mississippi River below Old River. (The New Orleans District initiated the

construction of an auxiliary control structure in July 1981. This control structure will serve to insure the integrity of the existing system. No changes in flow distribution or in stages would be effected by its installation.)

Modification of Existing Features, Where Required, to Pass the Project Flood. This includes the following: raising to grade the East and West Atchafalaya Basin Protection Levees and the levees west of Berwick (see Plate 5), and construction of approximately 429 miles of service roads on levee crowns; modifying Bayou Sorrel, Bayou Boeuf, and Berwick Locks; modifying the Charenton and East Calumet floodgates; modifying the Wax Lake East and Wax Lake West drainage structures; modifying culverts in the East and West Bayou Sale levees; and modifying the Upper Pointe Coupee, Centerville, Ellerslie, Franklin and Enlargement, Gordy, Maryland, North Bend, Wax Lake East, Wax Lake West, Bayou Yokely and Enlargement, Morgan City, and Tiger Island pumping plants. Since the EQ plan does not include channel training below Morgan City, the project flood flowline and levee grades would be somewhat higher than that achieved by implementing the other plans.

Bank Stabilization. Bank stabilization on the main channel above mile 55 would continue.

Training Works on the Atchafalaya Basin Main Channel Above Morgan City. This feature proposes the implementation of training works on the Atchafalaya Basin main channel to a height sufficient to confine average annual peak flows, approximately 450,000 cfs. This requires dredging approximately 29,000,000 cubic yards of material from 17.6 miles of channel, from mile 90.0 to mile 116.0, and placing it on the banks within diked areas to simulate development of natural ridges (Plate 6). The majority of the works would be below mile 94.0 and would be confining; that is, essentially no gaps would be left in the works to allow water to overflow the banks during low flows. Possible bank maintenance works may be required in the future along the main channel from mile 90.0 to mile 53.0 on the east bank and mile 55.0 on the west bank, but being very minor in nature, this was not included in cost estimates or impact assessments.

Sediment Control. The sediment control component of this plan includes realining the four principal distributaries of the Atchafalaya Basin main channel to reduce the entrance angle to between 30 and 45 degrees. These distributaries are the Old Atchafalaya River, the east freshwater distribution channel, west access channel, and east access channel (Plate 7).

70/30-Percent Distribution of Outlet Flows. This feature provides for maintaining the present flow distribution at the outlets by constructing a rock weir at the head of Grand Lake with connecting

levees to the West Atchafalaya Basin Protection Levee (Plate 8). The weir is designed to allow 30 percent of the low to normal flows to reach the gulf through Wax Lake Outlet, with the remaining 70 percent conveyed to the gulf via the Lower Atchafalaya River. For flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that floodflows could be safely conveyed to the gulf via the Wax Lake Outlet.

Widening Wax Lake Outlet Overbank. This feature consists of setting back the west Wax Lake Outlet levee an average of about 3 miles as shown on Plate 9. The existing west Wax Lake Outlet levee would be degraded to natural ground and a new West Calumet floodgate would be constructed.

Extension of Avoca Island Levee. Further extension of the Avoca Island levee is the only alternative which would provide protection over the entire area of backwater influence east of the floodway. However, more precise engineering and biological parameters must be defined to provide a better understanding of the complex, dynamic, and delicate ecosystem of the Atchafalaya Bay-Terrebonne marsh complex before implementation of further extensions of the levee and other structural or nonstructural features associated with backwater protection. The needed studies would be completed by 1985. Further rationale for delaying implementation of this plan feature is included in the Recommended Plan description.

Recreational Development. This feature consists of three developed and seven primitive campgrounds, one interpretative facility, and 15 boat-launching ramps located throughout the Atchafalaya Basin on 1,500 acres of acquired fee land (owner retains mineral rights).

Management Units. Thirteen management units (Figure 6) were studied to determine their feasibility for restoring historical overflow conditions to benefit the aquatic ecosystem. The studies to date indicate that five units (Buffalo Cove, Henderson, Beau Bayou, Flat Lake, and Cocodrie Swamp) have the greatest potential for accomplishing that goal. For this reason, these five were specifically included in the plan evaluation and the costs, benefits, and impacts developed for detailed plan comparison purposes. The Buffalo Cove and Henderson units are proposed as pilot units for initial implementation according to plans developed in conjunction with representatives of US FWS, US EPA, and appropriate state agencies. Subsequent to construction, the operation of these units would be closely monitored and an evaluation of their performance made by representatives of the cooperating agencies, using criteria devised by that group, concerning the pilot units' effectiveness. Based on that group's evaluation and recommendations, requests for funding to implement other units would be made. Prior to that time, it is not possible to determine how many additional units are feasible for implementation. Development of management units would require the restriction of their natural

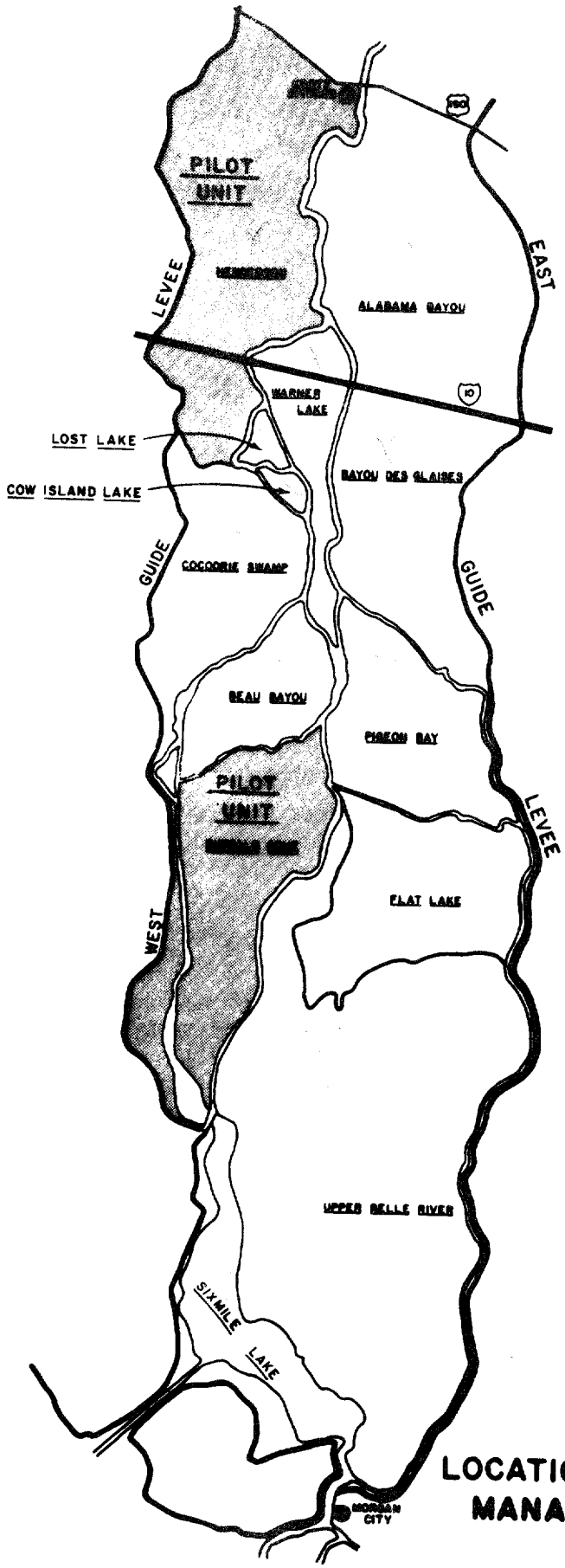


FIGURE 6
LOCATION OF PROPOSED MANAGEMENT UNITS

outlets by construction of weirs, and in some cases, low-level levees (see Plate 11). Construction of new inlets at the upper end of the management unit would also be necessary, as well as the closure of certain bayous and canals and the improvement of circulation within the unit. Rollovers to provide for small boat access would be installed at bayou and canal closures.

Freshwater Structures. This feature provides for implementation of the Henderson and Sherburne freshwater diversion structures to provide freshwater inflow from the Atchafalaya River to the Henderson Lake and Alabama Bayou areas, respectively. The Henderson structure would consist of a gated culvert designed to pass a maximum of 3,000 cfs into the upper region of the area. The exact location of this structure has not been determined as several feasible sites exist, but Bayou Graw in the vicinity of river mile 45.0 appears favorable. Studies to date, however, have ruled out the Bayou Courtableau and Indian Bayou sites. Studies during advanced planning and design would finalize a location for the structure. Plans would be developed to insure that diversion of the river water does not increase flooding on existing developed land or farmland in the vicinity of the structure nor cause a deterioration in the existing water quality in the presently impounded reach of lower Bayou Courtableau.

The Sherburne freshwater diversion structure, which also includes gated culverts of 3,000 cfs maximum capacity, would be located in the east Atchafalaya River levee at mile 43.0.

Real Estate Interests. The real estate feature of this plan provides for those interests needed to serve three basic functions: flood control, environmental protection, and public access. Real estate interests for both flood control and environmental purposes were developed in specific response to study objectives cited by the authorizing congressional resolutions. The public access function is ancillary to the proposed environmental features of the project, with the citizens of the State of Louisiana being the primary beneficiaries. The state expressed the view that public access in addition to the current state-owned lands (approximately 150,000 acres) was desirable. For this reason, the public access interests were developed in accordance with the November 1980 recommendations of the Governor.

The EQ plan provides a real estate feature which addresses both flood control and environmental protection purposes as follows:

- Flood Control. The Flood Control Act of 1936 authorized the US Army Corps of Engineers to acquire certain flowage rights in the Lower Atchafalaya Basin. The Act further specified: "That no flowage easements shall be paid for by the United States over properties subject to frequent overflow in the Atchafalaya Basin below the approximate latitude of Krotz Springs." It was

determined that about 68,000 acres in the Lower Atchafalaya Basin Floodway were subject to purchase of flowage easements under this Act. To date, those easements have been obtained on about 9,000 acres. The EQ plan includes the purchase of flowage rights on the remaining 59,000 acres. In addition, the right to prohibit the construction of new permanently habitable structures and to prohibit or regulate construction of other structures, including camps, would be acquired over all privately-owned land (approximately 445,000 acres) in the lower basin, except for the developed ridges. The need for developmental control is associated with operation of the floodway. This right would assure the lower floodway's readiness for operation on short notice, preclude the need for Corps of Engineers' emergency flood-fighting operations and associated Federal expenses within the basin, and insure no liability on the part of the Federal Government for the public health, safety, and welfare by controlling industrial development that could prove hazardous to the public during floodway operations. These developmental control rights would also serve to preserve the environmental values of the basin, but are considered essential elements of a flood control easement, which would provide for the continued unrestricted use of the lower floodway for project flood control purposes.

• Environmental Protection. Real estate interests for protection of environmental values in the lower basin were developed in response to general study goals of the authorizing congressional resolutions and specific study objectives as defined by the Agency Management Group, i.e., to "retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands." In addition to those rights needed for flood control, the EQ plan includes rights specifically for environmental protection. These rights are considered necessary for preservation of fish and wildlife habitat and maintaining the "wet and wild" environmental appeal of the lower floodway. Such rights would include control over all excavation and landfill operations and allow for extension of the time and duration of flooding by natural or artificial means. These rights would prevent or delay potential degradation of existing flowage patterns, prevent destruction of habitat, and provide for water level control under the management unit concept. Additional environmental rights would prohibit the conversion of land to other uses and provide control over the method of cutting timber. The land conversion control is directed at preventing destruction of fish and wildlife habitat, i.e., clearing of forests for the purpose of agricultural production of soybeans or other higher value economic pursuits. Control over timber is also aimed at preserving habitat, as well as maintaining the lower basin's environmental appeal by

controlling clearcutting and promoting sustained yield forestry practices. A comprehensive multipurpose easement, or higher interest if mutually agreed upon, containing the cited environmental interests would be acquired over the entire 445,000 acres of privately-owned land in the lower basin, except for the developed ridges.

• Public Access. The public access function was subdivided into two basic categories that relate to separate features of the proposed plan. The first, recreation development, was formulated in response to the study authorizing resolutions. The second, general public access, was developed in response to the Agency Management Group's objective to "maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway" and is based on the November 1980 recommendations of the Governor of the State of Louisiana.

For the recreational development feature, a total of 1,500 acres would be acquired in fee title in the proximity of the lower floodway to provide for the development of campsites, boat-launching ramps, and other facilities complementary to destination-type outdoor recreational activities. Included would be a limited number of day-use or picnicking sites and 200 to 500 acres set aside for special and unique areas.

The general public access feature would be accomplished by the acquisition of such additional rights on 103,500 acres of the same 445,000 acres previously cited for environmental protection easements. The public access areas would include 30,000 acres of late successional bottomland hardwood forests, 50,000 acres of cypress-tupelo swamps, 23,000 acres of greenbelts along the edges of selected navigable public waterways as well as sites along the interior toe of the basin protection levees, and 500 acres of existing rookeries. Additional rights to prohibit timber harvest would be obtained on 73,500 of the same acres on which general public access easements are acquired. This would apply to the 30,000 acres of bottomland hardwoods, 20,000 acres of cypress-tupelo stands, 23,000 acres of greenbelts, and 500 acres of rookeries. These rights are associated with the environmental goal of maintaining or enhancing productivity of the habitat, i.e., allowing the management of timber for fish and wildlife habitat improvement, as well as preserving existing esthetic values to benefit the public access user.

For all real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

Increase Sediment Through Wax Lake Outlet. This feature proposes dredging a new entrance channel from the Atchafalaya River into Wax Lake Outlet at an angle that would optimize sediment transport to Atchafalaya Bay (Plate 12).

Canal Closures and Circulation Improvements. This feature proposes the closing of certain canals that permit sediment-laden waters to enter backswamp areas, as well as improving water circulation patterns throughout the lower floodway by the selective opening of dredged material banks and other features that presently impede circulation.

Management Entity. The District Engineer would be the sole jurisdictional authority to protect and oversee Federal interests in the Atchafalaya Basin Floodway system upon implementation of the proposed comprehensive multipurpose plan. Recreation and environmental features of the plan would be operated and maintained by the appropriate Louisiana State agencies under license and lease agreements administered by the US Army Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on special studies and collateral interests as required by Federal law and Corps of Engineers' regulations.

COMPARISON OF DETAILED PLANS

Assessments of significant adverse and beneficial impacts for economic, social, cultural, and environmental values of the EQ plan are shown in detail in the Summary Comparison of Alternative Plans in Appendix B and are discussed in Sections 4 and 6 of the EIS.

When all nonflood control features are jointly evaluated, the EQ plan yields a 1.02 to 1 overall benefit-cost ratio for contributions to national economic development for nonflood control values. This is much lower than that of the NED plan and about equal to that for the Recommended Plan. The flood control aspects considered in detail for each plan are a part of the overall MR&T Project and thus, are not subject to incremental evaluation.

When the nonflood control features of the EQ plan are evaluated by separating the recreation development features from all other nonflood control features, the benefit-cost ratio for recreation development is 8.5 to 1 and the benefit-cost ratio for all other nonflood control features is 0.10 to 1. While the other nonflood features are primarily environmental, these features meet the national environmental quality objectives, and are justified by the many intangible benefits provided.

The EQ plan makes a highly positive contribution to each of the national environmental quality objectives, a net positive contribution to social well-being, but no net appreciable contribution to regional development objectives.

The EQ plan accomplishes the specific planning objective for flood control in a safe and environmentally sound manner. It exceeds other alternatives in accomplishing the objective of retaining and restoring unique environmental features of the floodways, and maintaining or enhancing the long-range productivity of the wetlands and woodlands. It also meets all obtainable objectives for reversible or controllable environmental conditions.

The objective of allowing agricultural and mineral development, provided that such activities do not interfere with flood control or the natural environment, is accomplished to the maximum practicable degree. The objective of maximizing natural delta formation while providing for navigation and passage of the project flood is accomplished by the plan. The objective of maximizing public opportunity for observing and utilizing fish and wildlife resources of the floodway is met through optimizing public access to aquatic resources by the implementation of recreation features and providing additional public access to the lower floodway's terrestrial resources.

The EQ plan's impacts evaluated under the associated evaluation criteria would likely be unacceptable to the majority of Atchafalaya Basin landowners and hunting clubs. It would, however, likely be acceptable to commercial fishermen and trappers, conservation groups, and general environmental interests. The completeness of the plan assumes a pre-authorization and post-authorization moratorium on land-clearing activities for success in achieving the environmental preservation goals associated with the defined real estate interests.

For contributions to national planning objectives/accounts, the EQ plan ranks second for the NED objectives, first for the EQ objectives, first for the social well-being objectives and second for the regional development objectives.

MITIGATION REQUIREMENTS

Mitigation requirements of the EQ plan would arise due to an estimated loss of 200 annualized habitat units (AHU's) of marsh habitat. However, since the implementation of this plan would result in a net gain of over 40,000 AHU's of bottomland hardwood/open land habitat and almost 3,000 AHU's of swamp habitat, it was assumed that these gains would offset the small loss of marsh habitat. Methods used in calculating mitigation needs are explained in Appendix G. Mitigation for any cultural resources losses would be as described for the NED plan.

IMPLEMENTATION RESPONSIBILITY

Cost allocation and cost apportionment by project purpose for the EQ plan are shown in Table 5. As noted in the table, costs are apportioned, using both the cost-sharing policy proposed by President Carter in his June 1978 water policy message to the Congress and the traditional cost-sharing policies. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, and relocations, and a cash contribution of $111,490,000 toward total construction costs. All estimated operation and maintenance costs would be borne by non-Federal interests.

Under traditional cost-sharing policy, all flood control costs are borne by the Federal Government (Section 2 and portions of Sections 3 and 4 of Public Law No. 391, 70th Congress). A non-Federal cash contribution of $2,201,000 toward construction costs of other features would be required in addition to a portion of lands, easements, rights-of-way, and relocations. The operation and maintenance costs attributed to recreation and enhancement of fish and wildlife would be borne by non-Federal interests.

For purposes of determining required Federal-state cost-sharing responsibilities, the Atchafalaya Basin is not a traditional water resources development project. Thus, the project should be considered exempt from the traditional policies, the President's cost-sharing policy, and provisions of PL 89-72, 89th Congress, S. 1229, 9 July 1965 under Section 6(e), which states in part that "cost-sharing and reimbursement provisions of the Act shall not apply to non-reservoir local flood control projects," beach erosion control projects, small boat harbor projects, hurricane protection projects, or "to project areas or facilities authorized by law for inclusion within a national recreation area or appropriate for administration by a Federal agency" as part of a national forest system, as part of the public lands classified for retention in Federal ownership, or "in connection with an authorized Federal program for the conservation and development of fish and wildlife." The pre-authorization study was authorized by both the House of Representatives and the Senate of the United States, as cited under Study Authority, i.e., "developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin, Louisiana, which would include...improvements of the area for commercial and sport fishing..."

The Atchafalaya Basin Floodway is a non-reservoir flood control project, but goes far beyond the scope of a local project. The project areas or facilities may become authorized by law to satisfy the intent of the study authority resolution which directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport fishing, as well as commercial fishing potential. The project or facilities are considered appropriate for administration by a Federal or state

TABLE 5

COST ALLOCATION AND COST APPORTIONMENT FOR THE FINAL ENVIRONMENTAL QUALITY PLAN

	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1/]		ANNUAL O&M		FIRST COST[1/]		ANNUAL O&M	
Purpose	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$596,528,000	$198,843,000	--	$14,439,000	$795,371,000	--	$14,439,000	--
Recreation	15,271,000	18,665,000	--	383,000[2/]	16,968,000	$16,968,000	--	$383,000[2/]
Enhancement of Commercial Fish	7,222,000	380,000	--	--	7,602,000	--	--	--
Enhancement of Fish and Wildlife	80,520,000	98,412,000	--	50,000	134,199,000	44,733,000	--	50,000
Mitigation	--	--	--	--	--	--	--	--
TOTALS	$699,541,000	$316,300,000	0	$14,872,000	$954,140,000	$61,701,000	$14,439,000	$433,000

[1/] Interest during construction is not included in costs.

[2/] Based on estimate included in Appendix F.

agency. In view of current administrative policy of placing more responsibility for the operation and maintenance of water resource projects in the hands of local authorities, it is intended that the State of Louisiana take responsibility for operation and maintenance of recreation developments and all other lands acquired for environmental management and general public access purposes, as included in this plan. Flood control features, and dredge and fill permits (Section 404 and Section 10) would remain under the control of the US Army Corps of Engineers. Federal real estate interests for recreational and environmental features of the plan would be administered through license and lease agreements with the state.

Lands of the Atchafalaya Basin are not part of a national forest system. However, further justification for exemption of the Atchafalaya Basin Floodway from cost-sharing requirements could be based on the basin's national environmental prominence as the largest forested wetland (river swamp) existing in the United States today that remains in a semi-natural state. The charge for preservation of this vast national resource, while maximizing public opportunity to observe and use its fish and wildlife resources, is clearly beyond the scope of traditional US Army Corps of Engineers' water resource development projects. The Governor of the State of Louisiana, in the state's Land Use Proposal, transmitted by letter 5 November 1980 to the District Engineer, recommended that "...management of non-flood control elements of the final Atchafalaya Basin plan should be through State of Louisiana agencies." This appears to more than satisfy previous legislative and executive intent for assuring local cooperation and participation in Federal flood control projects.

Under a cost-sharing arrangement, described in the preceding paragraphs, the Federal Government would bear a first cost of $999,903,000 and non-Federal interests a first cost of $15,938,000. Annual operation and maintenance costs of $14,439,000 associated with flood control would be borne by the Federal Government, while annual operation and maintenance costs of $433,000 for recreation and environmental protection and enhancement would be borne by non-Federal interests.

Final National Economic Development (NED) Plan

PLAN DESCRIPTION

This plan is comprised of a number of features which, when considered as a unit, provide for the lowest practicable project flood flowline. These features are discussed as follows:

70/30-Percent Distribution of Flows at Old River. This feature is identical to that described in the EQ plan description.

Modification of Existing Features, Where Required, to Pass the Project Flood. This component is similar to that described in the EQ plan, except that NED project features provide the lowest practicable project flowline and correspondingly lower grades for the East Atchafalaya Basin Protection Levee, the Atchafalaya River levees, the West Atchafalaya Basin Protection Levee, and the levees west of Berwick.

Bank Stabilization. Bank stabilization measures, such as articulated concrete mattresses and riprap placed above river mile 55.0 of the Atchafalaya River, would be required to control the meandering of the main channel to protect existing river levees (Plates 13-17).

Training Works on the Atchafalaya Basin Main Channel above Morgan City. This feature is identical to that described for the EQ plan.

Sediment Control. This feature is identical to that described for the EQ plan.

100/0-Percent Distribution of Outlet Flows. This feature provides for closing the Wax Lake Outlet to low and normal flows by constructing a rock weir at the head of Grand Lake, with connecting levees to the West Atchafalaya Basin Protection Levee. All low and normal flows would be conveyed to the gulf by the Lower Atchafalaya River. For flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that floodflows could be safely conveyed to the gulf through Wax Lake Outlet.

Widening the Wax Lake Outlet Overbank. This component is identical to that described for the EQ plan.

Training Works Below Morgan City. This feature consists of training works below Morgan City on both Wax Lake Outlet and the Lower Atchafalaya River and closure of Bayou Shaffer. Implementation of the training works would require dredging about 15 miles of existing channel bottom areas and placing the dredged material in adjacent shallow water bottoms or on adjacent stream banks to simulate the formation of natural levees. Gaps would be left between disposal areas to allow for continued development of the overbank wetlands, for navigation access, and for pipelines (Plate 18).

Extension of Avoca Island Levee. This feature provides for a 14,000-foot extension of the Avoca Island levee for the purpose of continuing backwater flooding protection in the area east of the lower floodway. The length of time for which continuing protection is provided by this alternative is highly dependent upon the actual rate of development of the Atchafalaya delta. This extension would include

a structure or structures to divert sufficient freshwater to maintain the present distribution of nonfloodflows, estimated to be 4,000 cfs, to the marshes in west Terrebonne Parish. The structure(s) would necessarily be closed when the stage at Amelia, Louisiana, reached 3 feet to provide an acceptable level of damage reduction from Lower Atchafalaya River backwater flooding.

This solution provides an interim period of protection which would allow completion of studies of the Atchafalaya Bay-Terrebonne marsh-backwater complex. Following more detailed engineering and biologic studies, a decision would be made on implementing further extensions or other means to address flood problems in the backwater area.

Real Estate Interests. The real estate feature of the NED plan provides only for those interests needed for two basic functions: flood control and recreation development. Real estate interests for both flood control and recreation development were developed in specific response to study objectives cited by the authorizing congressional resolutions.

The NED plan provides a real estate feature that addresses only flood control and recreational development purposes, which are identical to these two purposes as described in the EQ plan.

For all real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

Recreational Development. This feature is identical to that described for the EQ plan.

Management Entity. The District Engineer would be the sole jurisdictional authority over flood control features of the plan, and recreational features would be operated and maintained by Louisiana State agencies under license agreements administered by the US Army Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on collateral interests as required by Federal law and regulations.

COMPARISON OF DETAILED PLANS

Assessments of significant adverse and beneficial impacts for economic, social, cultural, and environmental values of the NED plan are shown in detail in Appendix B and in Sections 4 and 6 of the EIS.

The NED plan yields a 8.1 to 1 benefit-cost ratio for contributions to NED for nonflood control values, much higher than the

EQ and Recommended Plans. The flood control aspects of each plan considered in detail are a part of the overall MR&T Project and thus, are not subject to incremental evaluation.

This plan provides a negative contribution to all environmental quality national planning objectives but has only slight negative impacts on social well-being. It makes a positive contribution to regional development objectives.

The plan meets the specific planning objective to safely pass project floodflows, but because of the lower project flowline, it assumes that more environmental damages would occur than with the future without-project condition. It does not accomplish the natural environment objectives for retaining and restoring unique environmental features of the floodways or maintaining or enhancing productivity of existing natural resources.

Like the future without-project condition, this plan does not completely accomplish objectives for agricultural and mineral activities. Additionally, it does not accomplish the objective of maximizing delta formation. While the plan does not meet the specific goal of maximizing public access to the floodway, it does optimize public recreation facilities, thereby providing some additional opportunities for use of aquatic resources in the lower basin.

The NED plan's response to associated evaluation criteria would likely be unacceptable to environmental and commercial fishing interests, sport fishing clubs, and others who support habitat protection or enhancement in the floodway. It would, however, be more acceptable to agricultural and developmental interests in the lower floodway. The plan is complete and effective from the standpoint of project flood control protection.

For contributions to national planning objectives/accounts, this plan ranks first for the NED objectives and highest for the regional development objectives, but ranks lowest of the detailed plans considered for EQ and social well-being objectives.

MITIGATION REQUIREMENTS

Fish and Wildlife Habitat. Mitigation needs for the NED plan to replace loss of fish and wildlife habitat would arise due to the estimated loss of about 6,400 AHU's of bottomland hardwood and open land habitat, about 8,500 AHU's of flooded forest, about 3,000 AHU's of marshland habitat (If the entire Avoca Island levee extension was built, it would be necessary to replace 19,200 AHU's of marshland habitat.), and about 11,000 AHU's of swamp habitat.

The best method to mitigate for the loss of flooded forest habitat and about a third of the swamp habitat would be to build the Buffalo Cove management unit. (This assumes that building the unit would actually benefit aquatic resources.) This action would maintain the present water levels and thus, prevent clearing. At the present time, 23,910 acres of early successional bottomland hardwoods and 11,730 acres of cypress-tupelo are flooded yearly in Buffalo Cove. In the future with the NED plan, only 5,100 acres of early successional and 6,120 acres of cypress-tupelo forest would be flooded. Therefore, construction of the management unit would preserve flooding on 18,797 acres of early successional forest for a total of 5,075 AHU's preserved. Flooding would also be retained on 5,610 acres of cypress-tupelo forest for a total of 3,085 AHU's of flooded forest preserved. This flooding would also preserve about 4,000 AHU's of swamp habitat if it is assumed that a preservation credit of 1.0 for swampland could be saved by building the management unit. Thus, construction of the management unit would preserve a total of about 8,200 AHU's of flooded forest habitat and 4,000 AHU's of swamp habitat, which would mostly mitigate for the overall 8,500-AHU loss of flooded forest habitat. To mitigate for the remaining 7,100 AHU's of swamp habitat, it might be possible to build a water diversion structure that would direct sufficient Mississippi River water into existing swampland south of the river downstream from Donaldsonville, Louisiana, so that the habitat quality index of the swamps would be raised in a manner similar to that described for the future without-project plan. A structure similar to the one described below for marsh habitat mitigation would probably suffice. To mitigate for loss of 6,400 AHU's of bottomland forest/open land habitat it would be necessary to purchase and manage, as described for the future without-project condition, 16,800 acres of bottomland hardwood habitat. To mitigate for loss of 2,900 AHU's of marshland, it is proposed that management of marsh through freshwater introduction be carried out by diverting water from the Mississippi River into suitable areas adjacent to the river. Costs for these mitigation measures are shown in Table 6.

Cultural Resources. Responsibility to accomplish mitigation for losses of cultural resources is limited to National Register and Register-eligible properties subject to irreparable loss or destruction as the result of activities involving terrain alteration. The only existing project feature that has been subjected to an intensive cultural resources survey is the ongoing enlargement of the Atchafalaya Basin protection levees. Cultural resource mitigation requirements cannot be fully assessed until intensive cultural resource surveys of all features of the selected plans are completed. Mitigation requirements will then be determined for any cultural resources found eligible for inclusion in the National

TABLE 6

ESTIMATED MITIGATION COSTS FOR NED PLAN

Action	Total First Costs	Annual I&A[1]	Annual O&M [2]	Total Annual Costs
Purchase of 16,800 acres Bottomland Hardwood Forest	$13,144,000[3]	$1,003,000	$25,000[4]	$1,028,000
Freshwater Diversion (Swamp)	15,000,000	1,145,000	--	1,145,000
Freshwater Diversion (Marsh)	15,000,000[5] (100,000,000)[6]	1,145,000[5] (7,630,000)[6]	-- --	1,145,000[5] (7,630,000)[6]
Implement Buffalo Cove Management Unit	3,700,000[7]	282,000	10,000	292,000
TOTAL	$46,844,000[5] ($131,844,000)[6]	$3,575,000[5] ($10,060,000)[6]	$35,000 ($35,000)	$3,610,000[5] ($10,095,000)[6]

[1] Interest and Amortization - 7 5/8 percent for 100 years.

[2] Operation and Maintenance.

[3] Based on a unit land cost of $580 per acre, contingency cost of 25 percent, acquisition costs of $4,000 per tract for 110 tracts, development costs of $50 per acre, and total resettlement costs of $20,000.

[4] Assumed to be $1.50 per acre.

[5] Cost with first levee extension only.

[6] Cost for entire levee extension.

[7] Derived from data used in cost estimate preparation for the EQ plan.

Register that would be adversely affected by the project. Appendix E should be consulted for more information on this subject.

IMPLEMENTATION RESPONSIBILITY

Cost allocation and cost apportionment by project purpose for the NED plan are shown in Table 7. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, relocations, and a cash contribution of $98,747,000 toward total construction costs. All estimated operation and maintenance costs, except those attributed to mitigation, would be borne by non-Federal interests.

Under the traditional policy, non-Federal cash contribution of $8,991,000 toward construction costs of other features would be required, in addition to a portion of lands, easements, rights-of-way, and relocations. The operation and maintenance costs attributed to recreation would be borne non-Federal interests.

The study authority directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport fishing, as well as commercial fishing potential. The users and those who benefit from such activities transcend state boundaries. As is the case of traditional cost-sharing for flood control, recreation costs should also be borne by the Federal Government. Thus, the Federal Government would be responsible for a total first cost of $936,006,000, with non-Federal cost of $1,875,000. Operation and maintenance costs for flood control of $14,673,000 would be borne by the Government while non-Federal interests would bear annual costs of $383,000 for recreation.

The Recommended Plan

PLAN DESCRIPTION

The Recommended Plan combines features of the Environmental Quality Plan with features of the National Economic Development Plan into a compatible mix that addresses both national economic development and environmental quality objectives. Rationale for differences between this plan and the Tentatively Selected Plan reviewed during the July 1981 public meetings is included under the descriptions of affected plan features for clarity. The Recommended Plan consists of the following:

70/30-Percent Distribution of Flows at Old River. The Old River control structure is presently operated so that approximately

TABLE 7

COST ALLOCATION AND COST APPORTIONMENT FOR THE FINAL NATIONAL ECONOMIC DEVELOPMENT PLAN

	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1]		ANNUAL O&M		FIRST COST[1]		ANNUAL O&M	
Purpose	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$653,011,000	$217,670,000	--	$14,638,000	$870,681,000	--	$14,638,000	--
Recreation	9,160,000	11,196,000	--	383,000[2]	10,178,000	10,178,000	--	383,000[2]
Enhancement of Commercial Fish	--	--	--	--	--	--	--	--
Enhancement of Fish and Wildlife	--	--	--	--	--	--	--	--
Mitigation	35,133,000	11,711,000	26,000	9,000	46,844,000	--	35,000	--
TOTALS	$697,304,000	$240,577,000	26,000	$15,030,000	$927,703,000	$10,178,000	$14,673,000	$383,000

[1] Interest during construction is not included in costs; costs based on implementation of 14,000-foot extension of Avoca Island levee.

[2] Based on estimate included in Appendix F.

30 percent of the combined flows of the Red and Mississippi Rivers above Old River, Louisiana, are distributed to the Atchafalaya River, and 70 percent are distributed to the Mississippi River below Old River. This flow distribution is maintained on an annual basis. Various interest groups expressed a desire for this distribution to be modified slightly during certain times of the year. For example, farmers in the Red River backwater area would be able to plant earlier during some years if flow into into the Atchafalaya River was reduced sooner in the months of May, June, and July so that stages would not rise above 45 feet at Acme, Louisiana. However, the US FWS would like flows increased during the same months in some drier years to benefit the fishery resources in the lower floodway.

Subsequent to the July 1981 public meetings, additional studies of a possible short term variation in the 70/30 flow division were completed. It was determined that even short term changes in the authorized flow division are unacceptable for both engineering and environmental reasons. The previous studies supporting authorization of Old River control structure as well as subsequent analyses of development of the Atchafalaya and Mississippi Rivers over the period from 1973 to the present have shown that it is necessary to maintain not less than 70 percent of the total annual volume of latitude flow in the Mississipi River channel below Old River. This is essential for insuring that the Mississippi does not change course to its Atchafalaya River distributary, the shorter route to the gulf. Day-to-day departures from the 70/30 distirbution are possible, but the margin for such operation is quite limited because it is impossible to predict for any given year the subsequent hydrograph of latitude flow in order to ascertain the ability to redress any volumetric imbalances created by such departures. From an engineering standpoint, flows through Old River control structure could be reduced earlier in some years during May, June, and July to maintain a stage of 45 feet at Acme, Louisiana, for agricultural interests in the Red River backwater area. However, it is not feasible to increase flows significantly into the Atchafalaya River in other years to benefit fishery interests in the lower floodway because this would promote instability of the Atchafalaya-Mississippi River system and enhance the possible capture of the Mississippi River by the Atchafalaya. Thus, if Atchafalaya River flows could not be substantially increased during some years to mitigate for the lower flows of previous years, then significant environmental losses would occur in both the Lower Atchafalaya Basin Floodway and in the Red River backwater area. Additionally, other environmental losses would be caused by holding 45 feet at Acme even if it were possible to increase flows to the Atchafalaya River during drier years. Losses from both sources, analyzed on a worst-case basis, are summarized as follows:

- Induced clearing of about 1,000 acres of bottomland hardwood forests in the backwater area.

- Pollution of aquatic habitats in the backwater area and lower floodway, corresponding to increased agricultural activity.

- Reduction by one-half or more in water exchange within existing aquatic habitat in the backwater area. This induced degradation of habitat would cause a corresponding reduction in economic benefits from commercial and sport fishing.

- Elimination by the year 2030, of overbank flooding in the lower floodway on about 77,000 acres of forest and swampland. Losses from resultant degradation of aquatic habitat under 2030 conditions, for a year when the 45-foot stage limitation would be in effect, are summarized as follows.

Species	Annual Pounds Lost
Buffalo	145,000
Catfish	280,000
Crawfish	2,100,000
Sunfish	38,000
Largemouth Bass	64,000

These losses to commercial fisheries would result in a net loss of income of about $810,000.

- Reduction in freshwater input to the Atchafalaya Bay-Terrebonne Parish marsh complex, decreasing the amount the nutrients and organic matter transported to the estuarine area. Corresponding reductions in economic benefits for commercial fishing (shrimp, oyster, and menhaden) would be expected to occur.

An analysis of economic benefits to be generated from increased agricultural production and associated damages prevented in the Red River backwater area by maintaining 45 feet at Acme in May, June, and July revealed benefits of about $1.4 million annually. (Detailed analyses of benefits and impacts are included in Appendix B.) However, about 50 percent of these benefits would come from lands within the backwater area where previously authorized ring levee systems are being planned--systems which would not cause environmental losses in the Lower Atchafalaya Basin Floodway.

In summary, measurable economic losses to resources in the lower floodway from short-term variations in operation of the Old River control structure would not equal estimated benefits to agricultural and related activities in the backwater area. However, it is readily apparent that total economic losses to all commercial fisheries, both freshwater and marine, the timber industry, and sport and recreational activities would be substantial. Moreover, mitigation measures needed to replace fishery losses would be highly significant. For these

reasons, and because of the engineering restraints concerning the variable operation of the Old River structure, no short term changes in the authorized operation of the structure are recommended. (The New Orleans District initiated the construction of an auxiliary control structure in July 1981. This control structure will serve to insure the integrity of the existing system. No changes in distribution of flows or in stages would be effected by its installation.)

Modification of Existing Features, Where Required, to Pass the Project Flood. The project flood flowline for the Recommended Plan would be somewhat higher than that achieved by implementing the National Economic Development Plan. Thus, the East Atchafalaya Basin Protection Levee, West Atchafalaya Basin Protection Levee, Atchafalaya River levees, and the levees west of Berwick would require raising to a higher grade. Other works would include: construction of service roads on levee crowns; modifying Bayou Sorrel, Bayou Boeuf and Berwick locks; modifying the Charenton and East Calumet floodgates; modifying the Wax Lake East and West drainage structures, modifying culverts in the East and West Bayou Sale levees; and modifying the Upper Pointe Coupee, Centerville, Ellerslie, Franklin and Enlargement, Gordy, Maryland, North Bend, Wax Lake East and West, Bayou Yokely and Enlargement, Morgan City and Tiger Island pumping plants; and such other miscellaneous modifications, as required, to pass the project flood.

Bank Stabilization. Bank stabilization measures, such as articulated concrete mattresses and riprap, would be required along the Atchafalaya River above river mile 55.0 to control the meandering of the main channel for protection of the river levees (Plates 13-17).

Training Works on the Atchafalaya Basin Main Channel Above Morgan City. For development of the main channel, training works would be implemented on the Atchafalaya River main channel to a height sufficient to confine average annual peak flows, approximately 450,000 cfs. This would require dredging approximately 29,000,000 cubic yards of material from 17.6 miles of channel, from river mile 116.0 to mile 90.0, and placing it on the banks within diked areas to simulate the development of natural ridges (Plate 6). The majority of the works would be below mile 94.0 and would be confining; that is, essentially no gaps would be left in the training works to allow overflow of the banks during low flows. Possible bank maintenance works may be required along the main channel in the future from mile 90.0 to mile 53.0 on the east bank and mile 55.0 on the west bank. However, because this work would be very minor in nature, it was not included in cost estimates or impact assessments.

Sediment Control. The sediment control component of the Recommended Plan would confine more sediment transport to the main channel by realining the four principal distributaries of the Atchafalaya River to provide optimum distributary channel entrance angles. These

distributaries are the Old Atchafalaya River, east freshwater distribution channel, the west access channel, and the east access channel (Plate 7).

70/30-Percent (with Possible Future Change to Approximately 80/20-Percent) Distribution of Outlet Flows. This feature would implement a control structure for initially maintaining the present distribution of low to normal flows at the outlets, with about 30 percent conveyed through Wax Lake Outlet, by constructing a rock weir and connecting levees at the head of Grand Lake. The outlet system would be monitored in the future and if the area's ecosystem responds favorably, then flow into Wax Lake Outlet may be further restricted by modification of the rock weir to limit the low to normal flows entering Wax Lake Outlet to approach 20 percent. In either case, for flows exceeding a 10-year frequency, the low-level levees above Wax Lake Outlet would be overtopped to allow for safe conveyance of floodflows to the gulf.

Widen Wax Lake Outlet Overbank. This feature would require the setting back of the west Wax Lake Outlet levee an average of approximately 3 miles to the location shown on Plate 9. The existing Wax Lake Outlet levee would be degraded to natural ground and a new West Calumet floodgate would be constructed.

Training Works Below Morgan City. This feature of the Recommended Plan would implement channel training works below Morgan City on both Wax Lake Outlet and the Lower Atchafalaya River and close Bayou Shaffer. The training works would require dredging about 15 miles of existing channel bottom areas and placing the dredged material on adjacent shallow water bottoms or banks. Gaps would be left between disposal sites to allow for continued development of the overbank wetlands, navigation access, and for pipelines (Plate 18). The pumped material would be allowed to spread freely to the angle of repose, estimated to be 1 vertical on 40 horizontal. The elevation of the placed material would be limited to a height sufficient to confine average annual peak flows, an approximate average depth of 3 feet. This would result in an irregular series of relatively low mounds of dredged material, roughly parallel to the channels, which would simulate the formation of natural levees.

Extension of Avoca Island Levee. For this plan feature, implementation of further extension of the Avoca Island levee and/or other structural and nonstsructural measures associated with reductions in backwater flooding east of the lower floodway would be delayed until completion of additional studies defining the engineering and biological impacts of the proposed flood control features of the project on the Atchafalaya Bay-Terrebonne marsh-backwater area complex.

At the time of public release of the draft report, the proposed extension of the Avoca Island levee was determined to be the only

viable alternative for maintaining an equivalent amount of flooding over the entire area of backwater influence east of the Lower Atchafalaya Basin Floodway to generally the level of flooding experienced in that area during the 1945 flood, the protection criterion that the existing levee was provided to meet. The amount of flooding from backwater is dependent on the volume of floodflows conveyed through the floodway system as influenced by the flood control features and the natural alluvial riverine processes at work in the basin. The level of flooding from backwater is directly related to the water level or stage in the Lower Atchafalaya River at the end of the Avoca Island levee. The further development of the delta in Atchafalaya Bay will result in elongation of the river's course and thereby raise the stage at the end of the existing levee for a given discharge. Thus, if the existing levee is not extended, flooding caused by backwater influences on the area east of the floodway will become more frequent and to greater depths in relation to the rate of delta development over time. For this reason, a 14,000-foot extension of the Avoca Island levee was proposed as the Tentatively Selected Plan in the draft report of 22 June 1981 as an interim measure. This extension was to provide continued protection of the backwater area.

Because of the dynamic state of development of the delta and the environmental vulnerability of the marsh in the vicinity of the Avoca Island levee, substantial public opposition to extending the levee was expressed during the recent public review of the draft report. Review comments underscored both the environmental values of the Terrebonne marsh to the east of the proposed levee extension and uncertainty concerning potential impacts of the proposed work.

Since the public meetings, the multiple effects of all other proposed flood control features of the plan, but excluding the extensions of Avoca Island levee, have been investigated. The plan feature for widening the Wax Lake Outlet overbank would redistribute flow through the outlets for floods with the probability of occurring less frequently than once in 10 years, and thereby provide for reductions of stages in the Atchafalaya River. Such reductions for the more severe floods serve to reduce backwater flooding in the area east of the floodway.

As described in the draft report, the Avoca Island levee extension is a time-phased construction with the need for adding subsequent extensions directly related to future rises in the project flood flowline. This, in turn, is dependent on conveyance capacity in the Lower Atchafalaya River and accompanying delta development in Atchafalaya Bay.

During the study period to date, a large base of hydraulic and hydrologic engineering data has been generated relative to the analysis and selection of alternatives for improving the conveyance

capacity and efficiency of the floodway proper without undue environmental degradation. However, this data base was developed within acceptable confidence limits at the expense of precisely defining all associated hydraulic, hydrologic, and biologic parameters in the Atchafalaya Basin outside of the floodway.

Present engineering studies are not of sufficient scope to accurately determine the length of levee extension required to protect the area east of the floodway with the proposed flood control features in place. Ongoing model studies of delta growth will provide a more reliable basis for making this determination. In addition, further studies are needed for determining changes in subsidence, flow patterns, salinity regimes, and sediment transport within the Terrebonne marshes for the proper assessment of biological and environmental impacts. These studies can be accomplished concurrently with the ongoing model studies.

In summary, further extension of the Avoca Island levee is the only alternative which would provide protection over the entire area of backwater influence east of the floodway. However, more precise engineering and biological parameters must be determined to provide a better understanding of the impacts the recommended flood control features would have on the complex, dynamic, and delicate ecosystem of the bay-marsh complex before implementation of further extensions of the levee and/or other structural or nonstructural features associated with backwater protection. The needed studies would be completed by 1985.

Recreational Development. This feature of the Recommended Plan consists of three developed and seven primitive campgrounds, one interpretative facility, boat-launching ramps, and other facilities complementary to outdoor recreational activities. These facilities would be located in the proximity of the Lower Atchafalaya Basin Floodway on a total of 1,500 acres to be acquired in fee title (owner retains mineral rights). Details of recreation needs and development proposed are contained in Appendix F.

Management Units. Thirteen management units (Figure 6) were studied to determine their feasibility for restoring historical overflow conditions to benefit the aquatic ecosystem. The studies to date indicate that five units--Buffalo Cove, Henderson, Beau Bayou, Flat Lake, and Cocodrie Swamp--have the greatest potential for accomplishing that goal. For this reason, these five were specifically included in evaluation of the Recommended Plan and the costs, benefits, and impacts were developed for detailed plan comparison purposes. The Buffalo Cove and Henderson units would be implemented as pilot units in accordance with plans developed in conjunction with representatives of the US FWS, US EPA, and appropriate state agencies. Subsequent to construction, the operation of these units would be closely monitored and an evaluation of their performance made by representatives of the

cooperating agencies, using criteria devised by that group, concerning the pilot units' effectiveness in enhancing the aquatic environment. Based on that group's evaluation and recommendations, requests for funding to implement other units would be made. Prior to that time, it is not possible to determine how many additional units are feasible for implementation from both an engineering and environmental standpoint. Development of management units would require the restriction of natural outlets by construction of weirs and, in some cases, low-level levees (see Plate 11). Construction of new inlets at the upper end of the units would also be necessary, as well as the closure of certain bayous and canals and the improvement of circulation within the units. Rollovers to provide for small boat access would be installed at certain bayou and canal closures.

Freshwater Structures. This feature proposes the implementation of the Courtableau and Sherburne freshwater diversion structures to provide water inflow from the Atchafalaya River to the Henderson Lake and Alabama Bayou areas, respectively. The Courtableau freshwater diversion structure would be relocated to the vicinity of Bayou Graw at river mile 45.0 to serve as an inlet for the Henderson Lake area. It would consist of gated box culverts designed to convey a maximum of 3,000 cfs through the west Atchafalaya River levee. The initially proposed Bayou Courtableau site was changed in response to comments received during public review of the draft report. Studies completed since August 1981 indicated than an alternate site near Bayou Graw is more feasible and the Bayou Courtableau and Indian Bayou sites were eliminated from further consideration. Advanced planning and design will determine the exact location of the structure and insure that the freshwater diversion does not increase flooding on existing developed land or farmland, nor cause a deterioration of water quality in the presently impounded reach of lower Bayou Courtableau.

The Sherburne freshwater diversion structure, which also includes gated culverts of 3,000 cfs capacity, would be located in the east Atchafalaya River levee at mile 43.

Real Estate Interests. The real estate feature of the Recommended Plan provides for those interests needed to serve three basic functions: flood control, environmental protection, and public access. Real estate interests for both flood control and environmental purposes were developed in specific response to study objectives cited by the authorizing congressional resolutions. The public access function is ancillary to the proposed environmental features of the project, with the citizens of the State of Louisiana being the primary beneficiaries. The state expressed the view that public access in addition to the current state-owned lands (approximately 150,000 acres) was desirable. For this reason, the public access interests proposed in the Tentatively Selected Plan of the draft report were developed in accordance with the recommendations of the Governor.

During the public meetings of July 1981, general opposition was expressed to the greenbelt portion of the plan by landowners and hunters, while the greenbelts were generally favored by environmental interests. Additionally, landowners voiced opposition to the public access easements and originated an alternate proposition whereby the state would be offered certain lands for acquisition on a "willing seller" basis. These lands plus those included in an impending donation to the state by the Dow Chemical Company were proposed as a substitute for the public access easements cited in the draft report. The comprehensive multipurpose easements proposed for flood control and environmental protection over the entire Lower Atchafalaya Basin Floodway were generally supported by both landowners and environmental groups and remained as part of the landowners' alternative proposal.

Subsequent to the July meetings, a compromise proposal for public access was developed through the cooperative efforts of major opposing interests. Prominent national and local environmental organizations worked with representatives of the landowners and the state toward this end. A key element of the new proposal which makes it acceptable to the environmental community is a recommended tightening of provisions of the comprehensive multipurpose easement to prohibit land-use conversion. A key issue resolved by the new proposal is the elimination of the "greenbelts" included under the prior public access proposal. The details of the new alternative for public access were announced by Governor David C. Treen during a press conference on 19 November 1981, as a substitute for the public access provisions he had recommended in November 1980 and which were adopted in the draft report.

The Recommended Plan provides a real estate feature which addresses both flood control and environmental protection purposes as follows:

- Flood Control. The Flood Control Act of 1936 authorized the US Army Corps of Engineers to acquire certain flowage rights in the Lower Atchafalaya Basin. The Act further specified: "That no flowage easements shall be paid for by the United States over properties subject to frequent overflow in the Atchafalaya Basin below the approximate latitude of Krotz Springs." It was determined that about 68,000 acres in the Lower Atchafalaya Basin Floodway were subject to purchase of flowage easements under this Act. To date, those easements have been obtained on about 9,000 acres. The Recommended Plan proposes the purchase of flowage rights on the remaining 59,000 acres. In addition, the right to prohibit the construction of new permanently habitable structures and to prohibit or regulate construction of other structures, including camps, would be acquired over privately-owned land (approximately 367,000 acres) in the lower basin, except for the developed ridges. The need for developmental

control is associated with operation of the floodway. This right would assure the lower floodway's readiness for operation on short notice, preclude the need for Corps of Engineers' emergency flood-fighting operations and associated Federal expenses within the basin, and insure no liability on the part of the Federal Government for the public health, safety and welfare by controlling industrial development that could prove hazardous to the public during floodway operations. These developmental control rights would also serve to preserve the environmental values of the basin, but are considered essential elements of a flood control easement which would provide for the continued unrestricted use of the lower floodway for flood control purposes.

• Environmental Protection. Real estate interests recommended for protection of environmental values in the lower basin were developed in response to general study goals of the authorizing congressional resolutions and specific study objectives as defined by the Agency Management Group, i.e., to "retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands." In addition to those rights needed for flood control, the Recomended Plan proposes other rights specifically for environmental protection. These rights are considered necessary for preservation of fish and wildlife habitat and maintaining the "wet and wild" environmental appeal of the lower floodway. Such rights would include control over all excavation and landfill operations and allow for extension of the time and duration of flooding by natural or artificial means. These rights would prevent or delay potential degradation of existing flowage patterns, prevent destruction of habitat, and provide for water level control under the proposed management unit concept. Additional environmental rights would prohibit the conversion of land to other uses and provide control over the method of cutting timber. The proposed land conversion control is directed at preventing destruction of fish and wildlife habitat, i.e., clearing of forests for the purpose of agricultural production of soybeans or other higher value economic pursuits, such as industrial development. Control over timber is also aimed at preserving habitat as well as maintaining the lower basin's environmental appeal by controlling clearcutting and promoting sustained yield forestry practices. A comprehensive multipurpose easement, or higher interest, if mutually agreed upon, containing the cited environmental interests would be acquired over 367,000 acres of privately-owned land in the lower basin, except for the developed ridges.

• Public Access. The public access function was subdivided into two basic categories that relate to separate features of the proposed plan. The first, recreation development, was

formulated in response to the study authorizing resolutions. The second, general public access, was developed in response to the Agency Management Group's objective to "maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway" and is based on the substitute proposal of the Governor of the State of Louisiana, as announced in his press conference during November 1981.

For the recreational development feature, a total of 1,500 acres would be acquired in fee simple title in the proximity of the lower floodway to provide for the development of destination-type and primitive campsites, boat-launching ramps, and other facilities complementary to outdoor recreational activities. Included would be a limited number of day-use or picnicking sites and 200 to 500 acres set aside for special and unique areas, such as rookeries.

The general public access feature would be accomplished on the 150,000 acres of existing state-owned lands and by the following additional state-managed lands. At least 30,000 acres have been recently made available for public access within the Lower Atchafalaya Basin Floodway through a donation to the State by the Dow Chemical Company. The donation consisted of lands, located in or near the lower floodway, in excess of 40,000 acres. At least 48,000 additional acres would be made available for public access within the floodway by fee title acquisition of lands from owners identified by the state as "willing sellers." Federal cost participation with the State will be recommended for the fee lands yet to be procured, in an amount equivalent to that proposed in the draft plan for full Federal acquisition of public access and timber easement rights. These proposed public access lands are associated with the environmental goal of maintaining or enhancing productivity of the habitat, i.e., allowing the management of timber for fish and wildlife habitat improvement, as well as preserving existing esthetic values to benefit the public access user.

For all new real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of project flood control features and are included in engineering cost estimates in Appendix C.

Canal Closures and Circulation Improvements. This feature proposes the closing of certain canals that permit sediment-laden waters to enter backswamp areas, as well as the selective opening of dredged material banks and other impediments to circulation for improving water circulation patterns throughout the lower floodway.

Management Entity. The District Engineer would be the sole jurisdictional authority to protect and oversee Federal interests in

the Atchafalaya Basin Floodway system upon implementation of the recommended comprehensive multipurpose plan. Recreation and environmental features of the plan would be operated and maintained by the appropriate Louisiana State agencies under license, lease, or other agreements administered by the US Army Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on special studies and collateral interests as required by Federal law and US Army Corps of Engineers' regulations.

COMPARISON OF DETAILED PLANS

Assessments of significant adverse and beneficial impacts for economic, social, cultural, and environmental values of the Recommended Plan are shown in detail in Appendix B and in Sections 4 and 6 of the EIS.

When all nonflood control features are jointly evaluated, the Recommended Plan yields a 1.01 to 1 overall benefit-cost ratio for contributions to national economic development for nonflood control values, which is about equal to the Environmental Quality Plan but much lower than the National Economic Development Plan. The flood control aspects of the plan are not subject to incremental evaluation because they are part of the MR&T Project.

When the nonflood control features of the plan are evaluated by separating the recreation development features from all other nonflood control features, the benefit-cost ratio for recreation development is 8.5 to 1 and the benefit-cost ratio for all other nonflood control features is 0.13 to 1. Despite their excess in costs over tangible NED benefits, the other nonflood control features are considered to be justified and are included in the Recommended Plan because of the many intangible environmental benefits provided.

Because of alternative plan features selected, the plan makes a highly positive contribution to all national environmental quality objectives, a net positive contribution to social well-being, but no net appreciable contribution to regional development objectives.

For the specific planning objectives of safe flood control in an environmentally sound manner, and protection and enhancement of the natural environment, this plan accomplishes these objectives essentially the same as the Environmental Quality Plan. All other specific planning objectives are met in the same manner as was possible to accomplish by the Environmental Quality Plan.

The Recommended Plan's response to associated evaluation criteria will be the most acceptable to basin landowners, environmentalists, commercial fishing interests in Terrebonne Parish, and fishing clubs, commercial fishermen, hunters, and trappers in the floodway.

The geographic scope of this plan is national in nature, and it is reversible to a moderate degree, whereas the NED plan would be irreversible like the future without-project condition.

For contributions to national planning objectives/accounts, the Recommended Plan ranks third to the National Economic Development Plan for achieving national economic development objectives, second to the Environmental Quality Plan for environmental quality objectives, first for social well-being, and second for regional development objectives. This plan offers the best overall balance, of all detailed plans considered, toward meeting the national economic objectives and environmental quality accounts.

MITIGATION REQUIREMENTS

No mitigation would be required by implementing this plan. Mitigation needs for the Recommended Plan would arise because of the estimated loss of 200 AHU's of marsh habitat. However, since implementation of this plan would result in a net gain of over 40,000 AHU's of bottomland hardwood/open land habitat and almost 3,000 AHU's of swamp habitat, it was assumed that these gains would more than offset the small loss of marsh habitat.

Cultural Resources. Losses of cultural resources associated with the Recommended Plan would be mitigated in the same manner described in the National Economic Development Plan.

IMPLEMENTATION RESPONSIBILITY

Cost allocation and cost apportionment by project purpose for the Recommended Plan are shown in Table 8. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, and relocations, and a cash contribution of $100,999,000 toward total construction costs. All estimated operation and maintenance costs would be borne by non-Federal interests.

Under the traditional cost-sharing policy, all flood control costs are borne by the Federal Government. No non-Federal cash contribution toward construction costs of other features would be required, in addition to a portion of lands, easements, rights-of-way, and relocations. Operation and maintenance costs attributed to recreation and management and enhancement of environmental resources would be borne by non-Federal interests.

TABLE 8

COST ALLOCATION AND COST APPORTIONMENT FOR THE RECOMMENDED PLAN

	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1]		ANNUAL O&M		FIRST COST[1]		ANNUAL O&M	
Purpose	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$575,920,000	$191,973,000	--	$15,606,000	$767,893,000	--	$15,606,000	--
Recreation	17,824,000	21,786,000	--	383,000[2]	19,805,000	19,805,000	--	383,000[2]
Enhancement of Commercial Fish	7,222,000	380,000	--	--	7,602,000	--	--	--
Enhancement of Fish and Wildlife	77,805,000	95,096,000	--	50,000	129,676,000	43,225,000	--	50,000
Mitigation	--	--	--	--	--	--	--	--
TOTALS	$678,771,000	$309,235,000	--	$16,039,000	$924,976,000	$63,030,000	$15,606,000	$433,000
					92.6%	6.3%		

[1] Interest during construction is not included in costs.

[2] Based on estimate included in Appendix F.

The rationale presented for the implementation responsibility for the Environmental Quality Plan is equally applicable to this plan, based on the selection of alternative features common to both plans. Because this project goes far beyond the scope of a local project in all aspects, particularly its national environmental prominence as the largest forested wetland (river swamp) existing in the United States in a semi-natural state, and the congressional mandate to develop "...a comprehensive plan for the management and preservation of water and related land resources of the Atchafalaya Basin, Louisiana...", the first cost of $936,797,000 for the project should be borne by the Federal Government with non-Federal interests bearing a cost of $51,209,000. Table 9 shows cost allocation of the nonstructural real estate feature of the Recommended Plan versus what was proposed in the Tentatively Selected Plan. It should be noted that total non-Federal costs increased from 9 percent to 27 percent, and even though the Recommended Plan total cost increased by over $19 million, the total Federal cost decreased by over $16 million. The annual Federal cost for operations and maintenance of flood control features would be $15,606,000, while non-Federal interests would be responsible for operations and maintenance of recreation facilities and management of environmental resources for fish and wildlife enhancement at an estimated annual cost of $433,000.

TABLE 9

COST ALLOCATION OF NONSTRUCTURAL REAL ESTATE FEATURE
(1 October 1981 Price Levels)

	Tentatively Selected Plan			Recommended Plan		
	Total	Federal	Non-Federal	Total	Federal	Non-Federal
Flood Control	$ 21,510,000	$ 19,635,000	$ 1,875,000[1/]	$19,732,000	$17,857,000	$ 1,875,000[1/] *
Environmental	114,866,000	100,803,000	14,063,000[1/]	100,538,000	86,475,000	14,063,000[1/] *
Public Access	31,422,000	31,422,000	--	66,693,000	31,422,000	35,271,000[2/]
Recreation	874,000	874,000	--	874,000	874,000	--
Total	$168,672,000	$152,734,000	$15,938,000	$187,837,000	$136,628,000	$51,209,000
Percent of Total	100	91	9	100	73	27

TOTAL = 15,938,000

1/ Credit for cost over 150,000 acres of state land.

2/ Credit for Dow Chemical Company donation to State of 30,000 acres. = $19,153,000

1985 = $20,000,000

Cost of "willing seller" fee purchase land of 48,000 acres ($47,540,000) in excess of TS plan public access cost ($31,422,000). = $16,118,000

1985 = $51,450,000

= $35,271,000

* TOTAL VALUE ALLOWED FOR STATE OWNED 150,000 ACRES (1985 VALUES)

FLOOD CONTROL = $ 2,100,000

PUBLIC ACCESS/ENVIRON. = 15,200,000

$17,300,000

COMPARISON OF FINAL PLANS

Comparative information on the final plans and future without-project condition (FWO), along with the rationale for the final plans for environmental quality, national economic development, and the Recommended Plan, are presented in detail in Appendix B, in the table entitled Summary Comparison of Alternative Plans. That table provides a comparison of all significant beneficial and adverse impacts of the final alternative plans that were used for the purpose of trade-off analyses and decision making. The table also describes major features of each alternative plan, displays plan response to planning objectives, and presents each plan's performance against specified evaluation criteria, as was summarized for each final detailed plan in the previous section of this report.

Comparison of Final Plans

All of the final detailed plans are structural plans. Even the no-action or future without-project plan assumes the continuation of structural works in the form of the Atchafalaya Basin protection levees. This is necessary because of the floodway's prominence in safely passing the project flood via the Mississippi River and its floodway systems.

The detailed plans do not contribute to water conservation for the purpose of beneficial reductions in water uses or water losses. The plans considered in detail do not provide practicable opportunities for water conservation in this sense.

Flood control features were considered to fall under the overall MR&T project benefit-cost ratio and consequently were not incrementally evaluated. The nonflood control aspects, when jointly evaluated, were economically justified for all plans. Of the total nonflood control benefits, a minimum of 89 percent would accrue to the proposed construction of recreation facilities. The other environmental features, while providing only limited economic benefits, were considered justified on the basis of their intangible benefits and contributions to the study goal of environmental protection. A detailed comparison of overall versus incremental evaluation of nonflood control features is presented in Appendix B.

Rationale for Designation of Final EQ Plan

Contributions to environmental quality are favorable changes in the ecological, cultural, and esthetic attributes of natural and cultural resources that sustain and enrich human life (US Water Resources Council, 1980). Most features of the Environmental Quality Plan would contribute toward this definition of environmental quality, as well as meet the overriding criteria of safely passing the project flood through the Atchafalaya Basin to the Gulf of Mexico. Thus, it was designated the EQ plan. The following paragraphs explain how these contributions would occur for each of the plan features which yield a significant environmental quality contribution. Features that were included in the Recommended Plan are so noted.

SEDIMENT CONTROL BY DISTRIBUTARY REALINEMENTS

This feature would contribute to flood control, along with the preservation of both natural and cultural resources, by slowing the rate at which the Lower Atchafalaya Basin Floodway is filling with sediment. This process of sedimentation is destroying wetlands and open water bodies within the floodway, and this not only reduces aquatic productivity, but lowers esthetic values and compounds the loss of cultural resource sites. This feature was included in the Recommended Plan.

MANAGEMENT UNITS

This feature would contribute to preservation of aquatic natural resources by restoring, to the degree practicable, historical water conditions within the environmentally and hydrologically distinct areas of the lower floodway. Restoration of water levels in some areas would benefit local residents and recreationists that depend upon the aquatic productivity of these resources for their livelihood or enjoyment. This feature was included in the Recommended Plan.

FRESHWATER DIVERSION STRUCTURES

These structures would generally provide the same contribution toward environmental quality objectives as would management units, because they would help preserve and improve aquatic natural resources and productivity. This feature was included in the Recommended Plan.

CANAL CLOSURES AND CIRCULATION IMPROVEMENTS

These would contribute to improvements in the aquatic environment by helping to prevent introduction of sediment into productive wetland and open water areas and by alleviating water quality problems attributed to poor water circulation in swampland areas. These improvements would, in turn, benefit local residents and recreationists who depend upon aquatic productivity either for livelihood or enjoyment. This feature was included in the Recommended Plan.

REAL ESTATE INTERESTS

Comprehensive multipurpose easements would undoubtedly be the most valuable feature of the EQ plan in terms of contributing to environmental quality objectives. These easements, by prohibiting land conversion in the floodway, controlling the method of cutting timber, and controlling excavation and landfill operations, would preserve much of the ecological productivity of the area on which local residents and recreationists depend, as well as preserve many of the esthetic attributes that make the basin unique. Public access and timber easements would allow enhancement of habitat productivity, and increase opportunities for public use and enjoyment of the environmental values of the floodway. For the Recommended Plan, state-owned lands would be substituted for public access and timber easements. The developmental controls to be obtained for flood control purposes would serve to protect environmental values of the lower floodway for both the EQ and Recommended Plans.

RECREATIONAL DEVELOPMENT

These features would contribute to an enrichment of human life by increasing public accessibility to, opportunity for, and enjoyment of the natural and cultural resources of the lower floodway. This feature was included in the Recommended Plan.

DISTRIBUTION OF OUTLET FLOWS: 70/30 LOWER ATCHAFALAYA RIVER/WAX LAKE OUTLET

This feature, to retain present distribution of outlet flows, would contribute to environmental quality by helping maintain the existing ecological trends in the bays south of the project-affected area.

INCREASE SEDIMENT DIVERSION AT WAX LAKE OUTLET

This feature is intended to increase delta development at the mouth of Wax Lake Outlet, which would contribute to environmental quality by increasing the formation of undisturbed marshland in Atchafalaya Bay. Little marshland is presently forming at this location and marshland formation at the mouth of the Lower Atchafalaya River is hampered by the necessity to maintain a navigation channel through the developing delta.

WIDENING WAX LAKE OUTLET OVERBANK AREA

This feature would greatly improve the ecological conditions of the overbank area by restoring river overflows and tidal influence to swamps and marshes in the overbank area. This feature was included in the Recommended Plan.

ALTERNATIVES TO REDUCE BACKWATER FLOODING EAST OF THE FLOODWAY

For this plan feature, implementation of further extension of the Avoca Island levee and/or other structural and nonstructural measures associated with reductions in the backwater flooding east of the lower floodway would be delayed until completion of additional studies defining the engineering and biological impacts of the proposed flood control features of the project on the Atchafalaya Bay-Terrebonne marsh-backwater area complex.

Alternatives to the 14,000-foot extension of the Avoca Island levee proposed in the draft report for the EQ plan feature included: the phased extension of the levee to a total length of 19.6 miles along the bayshore alinement (Plate 10); and, the 28-ring levee plan to protect the larger industrial developments and residential areas, with residences outside the levees to be protected by flood-proofing measures. Further extension of the levee was selected for the Tentatively Selected Plan because it is the only alternative considered in detail that reduces flood damages for the entire area affected by backwater flooding, i.e., regional protection. Additionally, of the feasible alternatives, the levee extension had the lowest estimated annual costs, including operations and maintenance.

The amount of flooding from backwater is dependent on the volume of floodflows conveyed through the floodway system as influenced by the flood control features and the natural alluvial riverine processes at work in the basin. Backwater stages will continue to rise in the future because of the continuing delta development, and its

accompanying river elongation. Thus, the need for regional protection of the area from backwater influences will continue to become more acute. While the 28-ring levee plan would provide complete protection from headwater, tidal, and backwater influences within the selected leveed areas (see Plates 23-25), this plan would leave the majority of the area unprotected in the face of ever-worsening backwater conditions. This would result in substantial residual backwater damages in the future. Additionally, the construction rights-of-way for the proposed ring levee alinements would require the relocation of about 1,900 existing residential, commercial, and public structures located along bayous or in other physically restricted levee construction areas. Further, all structures located outside of the ring levees would require raising, flood-proofing, or removal for prevention of flood damages. Finally, evacuation and transportation routes, most existing farmland, and other facilities outside of the rings would be subjected to the ever-increasing backwater flood stages.

Because of the dynamic state of development of the delta and the environmental vulnerability of the marsh in the vicinity of the Avoca Island levee, substantial public opposition to extending the levee was expressed during the recent public review of the draft report. Review comments underscored both the environmental values of the Terrebonne marsh to the east of the proposed levee extension and uncertainty concerning potential impacts of the proposed work.

Since the public meetings, the multiple effects of all other proposed flood control features of the plan, but excluding the extensions of Avoca Island levee, have been investigated. The plan feature for widening the Wax Lake Outlet overbank would redistribute flow through the outlets for floods with the probability of occurring less frequently than once in 10 years, and thereby provide for reductions of stages in the Atchafalaya River. Such reductions for the more severe floods serve to reduce backwater flooding in the area east of the floodway.

As described in the draft report, the Avoca Island levee extension is a time-phased construction with the need for adding subsequent extensions directly related to future rises in the project flood flowline. This, in turn, is dependent on conveyance capacity in the Lower Atchafalaya River and accompanying delta development in Atchafalaya Bay.

During the study period to date, a large base of hydraulic and hydrologic engineering data has been generated relative to the analysis and selection of alternatives for improving the conveyance capacity and efficiency of the floodway proper without undue environmental degradation. However, this data base was developed within acceptable confidence limits at the expense of precisely defining all associated hydraulic, hydrologic, and biologic parameters in the Atchafalaya Basin outside the floodway.

Present engineering studies are not of sufficient scope to accurately determine the length of levee extension required to protect the area east of the floodway with the proposed flood control features in place. Ongoing model studies of delta growth will provide a more reliable basis for making this determination. In addition, further studies are needed for determining changes in subsidence, flow patterns, salinity regimes, and sediment transport within the Terrebonne marshes for the proper assessment of biological and environmental impacts. These studies can be accomplished concurrently with the ongoing model studies.

In summary, further extension of the Avoca Island levee is the only alternative which would provide protection over the entire area of backwater influence east of the floodway. However, more precise engineering and biological parameters must be determined to provide a better understanding of the impacts the recommended flood control features would have on the complex, dynamic, and delicate ecosystem of the bay-marsh complex before implementation of further extensions of the levee and/or other structural or nonstructural features associated with backwater protection. The needed studies would be completed by 1985.

This feature was included in the Recommended Plan.

Rationale for Designation of Final NED Plan

This plan, like the other detailed plans, was developed with the overriding criteria to safely pass the project flood through the Atchafalaya Basin to the Gulf of Mexico. In addition to meeting this criteria, the NED plan specifically attempted to maximize contributions to the NED account for recreation and fish and wildlife resource enhancement, as well as agricultural enhancement. As a result, the plan was comprised of features that would meet these objectives and yet be implementable in terms of the economic, political, social, and environmental systems operating in the area.

Contributions to NED are explained in the following paragraphs for those plan features having a significiant NED contribution. Features that were included in the Recommended Plan are so noted.

TRAINING WORKS BELOW MORGAN CITY

This feature would contribute to a lowering of the flowline in the Lower Atchafalaya Basin Floodway, thereby reducing overbank

sedimentation and construction costs of other flood control features. This feature was included in the Recommended Plan.

CHANNEL ALINEMENT OF THE AVOCA ISLAND LEVEE

Rationale presented under the EQ plan for the 14,000-foot extension is equally applicable to the NED plan. Additionally, extension of the Avoca Island levee would enhance agricultural potential in the backwater area east of the lower floodway by preventing future rises in backwater flood stages. Selection of the shorter river channel alinement of the Avoca Island levee for this plan was based on its substantially lower construction costs compared to the alternative alinement along the shoreline (Plate 10).

RECREATIONAL DEVELOPMENT

This feature was included because it would generate positive net benefits attributable to the NED account. This feature is common to both the EQ and Recommended Plans.

100/0-PERCENT DISTRIBUTION OF OUTLET FLOWS

The distribution of outlet flows with no flow through Wax Lake Outlet would increase the total flow capacity of the outlets, resulting in a lower project flood flowline and thus, lower construction costs for other flood control features.

REAL ESTATE INTERESTS

Acquisition of easements for purposes other than flood control would not be required, since they would not make positive contributions to the NED account. Acquisition of 1,500 acres of fee land would be required for development of proposed recreation facilities.

Rationale for the Recommended Plan

As with the other plans, this plan meets the overriding criteria of safely conveying the project flood to the gulf. In addition to meeting this criteria, the Recommended Plan offers balance with respect to contributions to both the national economic development and environmental quality accounts. Thus, it would contribute to NED and EQ while being implementable in terms of the economic, political, social, and environmental systems operating in the study area (Plate 19).

Rationale for changes in the individual plan features from those proposed in the draft plan was included in the plan description under Assessment and Evaluation of Final Plans. Contributions to the environmental quality and national economic development accounts are identical to the features of those plans which are common to the final Recommended Plan, and are so noted under rationale for individual plan features of the Environmental Quality and National Economic Development Plans.

Table 10 contains a summary of costs, authorization status, and purpose of major features of the Recommended Plan.

TABLE 10

COSTS, AUTHORIZATION STATUS, AND PURPOSE OF FEATURES

RECOMMENDED PLAN
ATCHAFALAYA BASIN STUDY

Feature	Cost	Requires Congressional Authorization		Purpose				Remarks
		Yes	No	Flood Control	Environmental Quality	Public Access	Recreation	
Old River Control Structure, maintain present operation	No additional		X	X				
Modification of features to pass the project flood	$446,681,000		X	X				
Bank stabilization	$104,950,000		X	X				
Main channel development[1/]	$64,100,000		X	X				
Sediment control	$31,100,000		X	X				
Management Units	$23,730,000	X			X			
Real Estate Interests								REAL ESTATE: The Recommended Plan includes comprehensive multipurpose easements over 367,000 acres in the Lower Atchafalaya Basin Floodway, excluding developed ridges. In addition, public access rights would be provided in the lower floodway by the State of Louisiana on: 150,000 acres of existing state lands; more than 30,000 acres donated to the state by Dow Chemical Company; and by the fee title purchase of approximately 50,000 acres of lands identified by the state, with Federal cost participation.
Flood Control								
Development Control	$13,781,000	X		X				
Overflow Rights	$5,951,000		X	X				
Environmental	$100,538,000	X			X			
Access	$66,693,000	X				X	X	
Fee (Recreation)	$874,000	X				X	X	
Wax Lake Outlet overbank enlargement (8,000 acres)	$90,500,000		X	X				COST ALLOCATION OF THE REAL ESTATE PLAN:
Outlet Works	$10,830,000		X	X				Flood Control $19,732,000 Environmental Protection 100,538,000 Public Access 66,693,000 Recreation (1,500 acres) 874,000 $187,837,000
Backwater Flooding East of Morgan City[2/]	--		X	X				
Recreational Development	$19,169,000	X					X	
Freshwater Structures	$8,109,000		X		X			
Canal Closures and Circulation Improvements	$1,000,000	X			X			
TOTAL[3/]	$988,006,000[4/]							ENR to Oct 85 = 1.19

[1/] Includes channel training below Morgan City at $11,650,000.

[2/] Implementation after completing additional engineering and biological studies.

[3/] Does not include interest during construction.

[4/] Federal cost = $936,797,000; Non-Federal cost = $51,209,000 (see Table 9).

COMPARISON OF PROJECT COST ESTIMATES

Comparison of Estimates

Atchafalaya Basin, Louisiana, a feature of the main stem of the Mississippi River and Tributaries (MR&T) project, is based on the authorized comprehensive review of the MR&T project contained in House Document 308, 88th Congress, 2d Session, which is considered to be the base estimate for the main stem system. The current PB-3 is based on that estimate, escalated for general construction price level increases and subsequent General Design Memorandums, Real Estate DM's and Detail DM's. The Survey/Phase I GDM Recommended Plan estimate of $1,559,209,000 represents a net increase of $184,209,000 over the current PB-3 estimate, effective 1 October 1981, of $1,375,000,000. Table 11 shows a comparison of PB-3 and current cost estimates. A by-feature discussion of the differences follows:

ATCHAFALAYA RIVER NAVIGATION

Unchanged, feature complete.

LANDS AND DAMAGES (01)

The increase of $200,150,000 over the PB-3 estimate represents net increases of $31,093,000 for the flood control features (of which $29,218,000 is Federal and $1,875,000 is non-Federal) and $169,057,000 for the nonflood control (i.e., environmental) features (of which $119,723,000 is Federal and $49,334,0000 is non-Federal).

RELOCATIONS (02)

The increase of $42,034,000 over the PB-3 estimate represents a net increase of $41,989,000 for the flood control features and an increase of $45,000 for nonflood control features.

TABLE 11

COMPARISON OF ESTIMATES
(In Thousands of Dollars)

Feature	Description	Atch. Basin PB-3/1 Oct 81 Price Levels	Sur/PhI GDM 1 Oct 81 Price Levels	Net Change (+/-)
-	Atchafalaya River Navigation	304	304	--
01	Lands and Damages	17,107	217,257	+200,150
02	Relocations	42,839	84,873	+42,034
05	Locks	31,605	30,532	-1,073
06	Fish and Wildlife Facilities	5,952	6,020	+68
08	Roads, Railroads and Bridges	625	625	--
09	Channels and Canals	224,225	131,744	-92,481
11	Levees and Floodwalls	657,531	674,144	+16,613
13	Pumping Plants	21,676	22,661	+985
14	Recreation Facilities	5,525	15,333	+9,808
15	Floodway Control and Diversion Structures	15	15	--
16	Bank Stabilization	176,613	171,846	-4,767
18	Cultural Resources Preservation	103	103	--
19	Buildings, Grounds, and Utilities	14	14	--
30	Engineering and Design	95,388	109,322	+13,934
31	Supervision and Administration	95,478	94,416	-1,062
	Total Cost (Federal Cost and Non-Federal Contributions)	1,375,000	1,559,209	+184,209
	Required Non-Federal Contributions	3,000	51,209	+48,209
	Total Federal Cost	1,372,000	1,508,000	+136,000

LOCKS (05)

The decrease of $1,073,000 from the PB-3 estimate represents a net decrease for the flood control features.

FISH AND WILDLIFE FACILITIES (06)

The $68,000 increase over the PB-3 estimate is for nonflood control features.

ROADS, RAILROADS, AND BRIDGES (08)

Unchanged, feature complete.

CHANNELS AND CANALS (09)

The decrease of $92,481,000 from the PB-3 estimate represents a net decrease of $112,411,000 in the flood control features due to deletion of the main channel dredging feature and substitution of channel training and realinement features, partially offset by an increase of $19,930,000 in the nonflood control features.

LEVEES AND FLOODWALLS (11)

The increase of $16,613,000 over the PB-3 estimate represents a net increase of $15,278,000 in the flood control features due to addition of outlet control works, partially offset by a reduction in levee construction due to changes in the new flowline and an increase of $1,335,000 in nonflood control features.

PUMPING PLANTS (13)

The $985,000 increase over the PB-3 estimate is for flood control features.

RECREATION FACILITIES (14)

The increase of $9,808,000 over the PB-3 estimate includes addition of four sites and increased cost at the 22 previously authorized sites.

FLOODWAY CONTROL AND DIVERSION STRUCTURES (15)

Unchanged, feature complete.

BANK STABILIZATION (16)

The decrease of $4,767,000 from the PB-3 estimate represents a reduction of $19,167,000 for main channel bank protection, partially offset by an increase of $14,400,000 for channel realinement and training.

CULTURAL RESOURCES PRESERVATION (18)

Unchanged.

BUILDINGS, GROUNDS, AND UTILITIES (19)

Unchanged, feature complete.

ENGINEERING AND DESIGN (30)

The increase of $13,934,000 over the PB-3 estimate represents an increase of $9,963,000 for the flood control features and $3,971,000 for the nonflood control features.

SUPERVISION AND ADMINISTRATION (31)

The decrease of $1,062,000 from the PB-3 estimate represents a decrease of $5,187,000 in the flood control features, partially offset by an increase of $4,125,000 in the nonflood control features.

ATCHAFALAYA BASIN FLOODWAY SYSTEM, LA.

FINAL ENVIRONMENTAL IMPACT STATEMENT

PARISHES: CONCORDIA, AVOYELLES, POINTE COUPEE, ST. LANDRY, IBERVILLE, ST. MARTIN, IBERIA, ASSUMPTION, LAFOURCHE, TERREBONE, ST. MARY

LEAD AGENCY: U.S. ARMY CORPS OF ENGINEERS, NEW ORLEANS, LA.
COOPERATING AGENCIES: U.S. FISH AND WILDLIFE SERVICE
U.S. ENVIRONMENTAL PROTECTION AGENCY
STATE OF LOUISIANA

ABSTRACT: The Atchafalaya Basin Floodway system in south-central Louisiana is a safety valve for the floodwaters of the Mississippi River. The project area includes the Red River backwater area, the floodway system proper, the backwater area east and northeast of Morgan City, and the coastal marshes of south-central Louisiana. The New Orleans District and cooperating agencies have investigated passage of the project flood through the Lower Atchafalaya Basin Floodway (LABF), flood protection in the Morgan City backwater area, and protection of natural resources within the project area. Three plans were investigated in detail and have been updated as a result of public review during July 1981. All plans would maintain the present 70/30 distribution of flow between the Mississippi and Atchafalaya Rivers. Plan 4, the Environmental Quality (EQ) Plan, consists of levee raising, channel training, and bank stabilization of the Atchafalaya River; realinement of major distributaries for sediment control; water level management in the LABF; comprehensive multipurpose easements over the entire 445,000 acres in the LABF that are privately owned (excluding developed ridges); public access rights over 103,500 acres and timber rights over 73,500 acres of that same area; and fee purchase of 1,500 acres for recreational development and protection of environmentally unique areas; implementation of a solution for backwater flooding but only after completion of additional detailed studies; widening of Wax Lake Outlet (WLO) overbank; and diversion of sediment down WLO. This would provide for safe passage of the project flood and would protect environmental values. Plan 7, the National Economic Development (NED) Plan, consists of levee raising, channel training, and bank stabilization; distributary realinements; WLO overbank widening; extension of the Avoca levee by 14,000 feet; phased increase of the proportion of flow out of the Lower Atchafalaya River (LAR) until WLO is closed to normal flows; easements for developmental control over the entire LABF; and purchase of 1,500 acres for recreation. The NED plan provides flood protection similar to the EQ plan but would require extensive mitigation to replace environmental losses. Plan 9, the Recommended Plan, is similar to the EQ plan but includes channel training of the LAR and WLO; potential future change in flow distribution between the LAR and WLO from 70/30 to 80/20; implementation of a solution for backwater flooding after completion of additional detailed studies; and no diversion of sediment out of the WLO. In lieu of easements for public access, this plan incorporates donation and fee acquisition of about 78,000 acres of land. This plan also prohibits land-use conversion, maximizes project flood passage, and provides for protection of environmental values.

DATE: _____

Send your comments to OCE, ATTN: (DAEN-CWP) by the date stamped above. For further information on this statement, contact Dr. Tom Pullen, Jr., US Army Engineer District, New Orleans, LA. 70160. Commercial telephone (504) 838-2525; FTS: 687-2525.

NOTE: Information, displays, maps, etc. discussed in the Main Report and Appendixes are incorporated by reference in the EIS.

1. SUMMARY

Major Conclusions and Findings

1.1 In the 1930's, the Atchafalaya River in south-central Louisiana became the central channel of a 15-mile wide leveed floodway system passing through the center of the Atchafalaya Basin. The purpose of the floodway system was to convey up to half the annual floodwaters of the Mississippi River and its tributaries to the Gulf of Mexico. This final Environmental Impact Statement (EIS) is mainly concerned with proposed work that would affect the lower portion of the floodway system which consists of the Lower Atchafalaya Basin Floodway and adjacent coastal marshes. Project-induced effects in the backwater area northeast of Morgan City, Louisiana, are also addressed.

1.2 In addition to serving as a passage for floodwaters, the lower floodway is one of the largest remaining river overflow swamps in the continental United States and harbors a vast array of fish and wildlife resources. It produces an average of 15 million pounds of crawfish a year and serves as a recreational area for numerous hunters, fishermen, canoeists, and others who enjoy the out-of-doors. The northern portion of the lower floodway contains extensive bottomland hardwood forests, while the southern portion is a vast cypress-tupelo swamp with early successional bottomland hardwood forests developing as large lakes become filled with sediment. As the Atchafalaya River enters the estuarine area, it deposits sediment and is building a major delta.

1.3 The floodway has been slowly losing its capability to pass floodwaters due to continuing sedimentation problems. As the lower floodway fills with sediment, it loses flood-carrying capacity and can no longer safely carry the maximum (project) flood. In addition, the Atchafalaya is a geologically young, growing river and as it naturally enlarges its main channel, water levels in adjacent lakes and swamps drop. Thus, as a result of continuing sedimentation and falling water levels, lakes, bayous, and seasonally flooded forests are becoming dryer and will eventually cease to support the rich aquatic resources they support today. As the forests dry, it becomes highly profitable to clear them for agriculture. It is estimated that by the year 2030, over half the existing 332,000 acres of bottomland hardwood forest would be cleared if no preventative actions were taken. As the delta develops, it will increasingly reduce water and sediment flows to the western Terrebonne Parish marshes and the rate of deterioration of those marshes will increase. The enlargement of the delta is causing water levels to rise in the backwater area east and northeast of

Morgan City. If flood protection of some sort is not provided, this phenomenon would eventually force homes, businesses, and industries to relocate and the prolonged flooding could slow forest growth and regeneration. About 10,000 acres of existing farmland could also be adversely affected (about 3,000 acres of this would probably eventually receive protection in the form of currently proposed local interest ring levee systems).

RATIONALE FOR THE ENVIRONMENTAL QUALITY (EQ) PLAN

1.4 The individual features of Plan 4 (EQ) were chosen to preserve or to maximize favorable changes in ecological, cultural, and esthetic resources or to insure that a minimal irretrievable commitment of resources would be made if this plan were implemented. Since one of the overriding goals of the project is the safe passage of the project flood, some features of the EQ plan were chosen to meet this necessity and not specifically for their EQ contribution. A 70/30 distribution of flows at Old River, Louisiana, was chosen, so that 70 percent of the flow continuing down the Mississippi River and 30 percent down the Atchafalaya River would preserve present conditions with regard to total annual water flow. Raising of the subsiding East and West Atchafalaya Basin Protection Levees, the Atchafalaya River levees and levees west of Berwick, Louisiana, is necessary for flood control. Channel training of the main channel of the Atchafalaya River, in lieu of other measures to increase flood-carrying capacity, was chosen for the EQ plan because it would cause a sizable reduction in the amount of sediment entering swamps and lakes. The feature that would make the largest contribution to the EQ account is the provision for easements that would prohibit development and clearing for agriculture in the entire lower basin and allow public access on 105,000 acres, including 23,000 acres of greenbelts along navigable streams and the inside toe of perimeter guide levees. By preventing the loss of forests, these easements would preserve ecological productivity as well as many of the attributes which make the basin unique. The 1980 State of Louisiana proposal for public access is retained in this plan because it provides protection for far more acres of cypress-tupelo than the recommended substitute public access plan. Recreational development would allow millions of people to enjoy the semiwilderness experience of the basin. Realinement of distributary channels would help preserve both natural and cultural resources by slowing the rate at which the lower basin is filling with sediment, a process which results in loss of aquatic productivity and in burying of archeological sites. Construction of management units, hydrologically distinct areas in which existing water levels would be maintained to the degree possible, would contribute significantly to aquatic productivity and benefit recreationists and commercial fishermen. However, construction of those units might inconvenience the oil and gas industry and would reduce terrestrial productivity somewhat compared to what would

occur under future without-project conditions. The two freshwater diversion structures near Krotz Springs would also help preserve the aquatic system. Closure of selected canals would reduce sedimentation in wetlands and open water areas. Circulation improvement features would help lessen water quality problems caused by poor water movement. Preserving the present distribution of flows at Wax Lake and the Lower Atchafalaya River Outlets would help maintain existing ecological trends in coastal bays and marshes. By increasing the amount of sediment diverted out Wax Lake Outlet, the amount of undisturbed deltaic marsh in Atchafalaya Bay would be increased. The widening of the Wax Lake Outlet overbank area would be of great benefit to the aquatic system by restoring about 7,800 acres of swamp and marsh to the river and tidal system. The EQ plan contains no provisions to immediately solve the backwater flooding problems in the area northeast of Morgan City. Other features of the plan, such as the widening of the Wax Lake overbank area, would help reduce the magnitude of this problem in the near future for the more severe floods. In the meantime, additional detailed studies of the dynamic and delicate bay-marsh ecosystem would be completed by 1985 to gather data which would be used to help determine if extension of the Avoca Island levee, or other structural or nonstructural alternatives, would be an acceptable solution, from both a flood control and an environmental standpoint.

RATIONALE FOR THE NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

1.5 In choosing features of Plan 7 (NED), specific attempts were made to maximize contributions to the NED account for agricultural enhancement and fish and wildlife preservation. This plan was developed with the major goal of safely passing the project flood in the most economical manner. Training works along the Lower Atchafalaya River and Wax Lake Outlet and along the main channel would produce a lower flowline than with any other plan investigated. The closure of Wax Lake Outlet to all but floodflows would also lower the flowline. Thus, the east and west protection levees would be lower and less costly than with any other alternative. Extension of the Avoca Island levee for 14,000 feet would continue to reduce economic damages in the backwater area east and northeast of Morgan City for an interim period. Acquisition of occasional flowage easements that allow flooding due to operation of the project and prevent structures for human habitation and other uses or structures, as well as control excavations and fill, would make a contribution to the NED account as would development of recreational features. Construction of the Buffalo Cove management unit, purchase of 16,800 acres of bottomland hardwood forest for a wildlife management area, and marsh and swamp management by freshwater diversion would mitigate for the environmental losses caused by this plan.

RATIONALE FOR THE RECOMMENDED (R) PLAN

1.6 As with other plans, Plan 9 (R) was developed with the overriding criterion of safely passing the project flood. It was selected as the Recommended Plan because of the balance it offers with respect to contributions to the NED and EQ accounts as well as because it proposes a substitute public access plan which appeals to a wide spectrum of special interest groups. Sediment control and channel training above and below Morgan City, and works which could eventually regulate the outlets to an 80/20 distribution would result in a lower flowline than with the EQ plan and thus, lower and less costly protection levees. The combination of flowage and environmental easements would preserve environmental values. Construction of management units, freshwater diversion structures, canal closures, and circulation improvements would collectively produce significant benefits to the aquatic ecosystem. Widening the Wax Lake Outlet overbank would aid in flood control while improving aquatic productivity within the overbank area. This plan, like Plan 4, contains the provision to implement an alternative to solve the backwater flooding problems in the area northeast of Morgan City only after completion of additional studies. Until this decision is made, some relief from these problems would be provided by implementation of other plan features. The Recommended Plan includes the proposed acquisition of easements on 367,000 acres which would, among other things, prohibit conversion of wetlands and woodlands to other habitat types and provide for the operation of management units. Public access to an additional 78,000 acres of floodway lands and 10,000 acres of lands near the floodway made available by donation or acquisition from willing sellers is also included. Acquisition of and recreational development on 1,500 acres in the lower floodway would provide substantial new public recreation opportunities. While it is recognized that some losses to environmental values would occur due to construction of various project features, it is considered that these losses would be mitigated by the overall positive environmental contribution of the nonstructural real estate features of the plan.

SECTION 404 FINDINGS

1.7 The provisions of Section 404 of the Clean Water Act for all project features except levees, floodwalls and bank stabilization will be met via the Section 404(r) process by the submission of this EIS, including a Section 404(b)(1) Evaluation, to Congress for appropriation and/or authorization action. The levees, floodwalls, and bank stabilization features will meet Section 404 provisions by preparation of a Section 404(b)(1) Evaluation. A Public Notice will be prepared and a Water Quality Certificate will be requested from the State of Louisiana for these three features. This course is necessary because items of these three authorized features are scheduled for

construction in the near future and the Section 404(r) exemption process is too lengthy to complete prior to construction on these items. Certain other features are also authorized. If it is deemed necessary to construct any of these features prior to completion of the Section 404(r) process, the Public Notice/State Water Quality Certification process will be utilized.

1.8 The nine project features comprising the Recommended Plan have been evaluated with respect to Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, published by the US Environmental Protection Agency on 24 December 1980. These evaluations are included in Appendix G of this report. The potential for environmental impact of each disposal activity was estimated on the basis of currently available engineering design data, and the pertinent physical, chemical, and biological information that had been compiled as a result of this and other studies and investigations. Efforts were made to identify the least environmentally damaging practicable alternative for each disposal site, wherever such alternatives were available.

1.9 No particular violations of applicable State of Louisiana water quality standards, other than for turbidity during construction operations, were found. No potential violations of the Toxic Effluent Standards of Section 307 of the Clean Water Act as a result of dredging operations were determined where practicable alternative sites are available. Although some of the selected disposal activities would destroy minor portions of the habitat of certain endangered or threatened species, those effects would be mitigated by the proposed environmental easements.

1.10 It was found that the proposed material discharges would not cause or contribute to significant adverse effects on: human health; the life stages of organisms within the aquatic ecosystem; or ecosystem diversity, productivity, and stability. Nor were there any significant adverse impacts identified on recreational, esthetic, or economic values. Some of these evaluations will be refined and updated when more site-specific water, sediment, and disposal area physical and/or chemical data become available. In the interim, the proposed dredged material disposal sites are found to be in compliance with the current Section 404 guidelines.

FINDINGS ON EXECUTIVE ORDER 11988

1.11 The proposed action would occur within a flood plain. A large number of practicable alternatives have been identified and are discussed and evaluated in Section 4. No nonflood plain alternatives exist. Section 6 describes the beneficial and adverse impacts of each alternative and describes any expected losses of natural flood

plain benefits. Views of the general public have been obtained at several public meetings. Plan 9 (R) and Plan 4 (EQ) recognize the significant value of the Atchafalaya River flood plain and include comprehensive easements to preserve forestland and prevent permanent human habitation in the floodway portion of the flood plain. Plan 7 (NED) contains similar easements to control development and prevent human habitation. In conclusion, the Recommended Plan is the most responsive to the planning objectives established for the study and is consistent with the requirements of Executive Order 11988.

FINDINGS ON EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

1.12 Since extensive wetlands are present in the study area, one of the project planning objectives was to maintain or enhance the long range productivity of wetlands and woodlands. There were no practicable alternatives to locating some project features in wetlands. The Avoca Island levee and ring levees around population and industrial centers were considered, but were eliminated from final consideration in the Recommended Plan due to uncertainty over which would be the most desirable solution to backwater flooding problems and to the fact that widening the Wax Lake overbank area would help reduce flood damages in this area until more data can be collected with which to determine the most acceptable solution to this problem. Channel training above Morgan City and levee raising work would involve destruction of wetlands, but there is no practicable nonwetland alternative to these measures so they were included in all plans. During plan formulation, wetland protection measures to minimize unavoidable adverse impacts were included in each plan. Environmental easements and management units in the floodway are part of Plans 4 (EQ) and 9 (R) and nondevelopment easements are a part of Plan 7 (NED). Freshwater diversion through the Avoca Island levee extension is part of Plan 7 (NED) even though only Reach 1 (14,000 feet) is proposed for construction. Adverse impacts to wetlands are discussed in Section 6 of this EIS. In conclusion, Plan 9 (R) is the one most responsive to planning objectives and evaluation criteria.

Areas of Controversy

1.13 Throughout the course of the study, there have been a number of major interagency controversial issues, most of which have been resolved. These are discussed in the subsequent paragraphs.

1.14 Most Probable Future. This issue concerned the use of most probable future (MPF) as the basis on which to compare alternatives or

the use of present conditions or MPF conditions based on a base year prior to man's alteration of the natural environment. The US Fish and Wildlife Service maintains that the true future without-project condition has not been defined. It argues that the future without-project condition described in this report is based upon an environmental profile which developed as a partial result of past flood control activities which have accelerated environmental losses. This issue has not been totally resolved. However, the established legal requirements of Principles and Standards (Water Resources Council, 1980) have been used in formulating the MPF condition profile.

1.15 Need for Additional Easements for Flood Control in the Lower Atchafalaya Basin Floodway. Environmental interests contended that additional easements for flood control were needed in the Lower Atchafalaya Basin Floodway. The US Army Corps of Engineers' past position has been that no additional real estate interest was needed for flood control. In this study, the District Engineer is recommending a more comprehensive easement, principally to control developments in the basin which would affect its use for flood control.

1.16 Recreation User-Day Values. The US Fish and Wildlife Service suggested using a set of values for recreation user-days based largely on the "time-value" or "income foregone" methodology. The US Army Corps of Engineers suggested use of values from Principles and Standards (Water Resources Council, 1979). Because of the uniqueness of the study area, the selection of user-day values actually used was based on a US Fish and Wildlife Service/US Army Corps of Engineers site-specific analysis contracted to Professor Fred Bell of Florida State University in 1979-1980 (Bell, 1981a).

1.17 Fee Acquisition of the Lower Atchafalaya Basin Floodway. The single most controversial issue in the course of the study has been the proposal recommending acquisition in fee of most privately-owned lands in the Lower Atchafalaya Basin Floodway (exclusive of mineral rights). Public meetings in January 1979 polarized around this particular issue. The Recommended Plan presented in this EIS includes a wide array of real estate interests varying from flowage easements to fee acquisition of 1,500 acres for recreational features and additional state fee acquisition of approximately 48,000 acres of land from willing sellers, with Federal participation.

1.18 Number of Management Units. The US Environmental Protection Agency and US Fish and Wildlife Service desire construction of all management units. US Army Corps of Engineers studies to date indicate that five of the units have the greatest potential for restoring historical conditions to benefit the aquatic ecosystem. Thus, costs, benefits, and impacts of these units were developed for plan evaluation purposes. The Buffalo Cove and Henderson units are proposed as pilot units for initial implementation according to plans developed in

conjunction with representatives of the US Fish and Wildlife Service, US Environmental Protection Agency, and appropriate state agencies. After construction, the pilot units would be monitored and an evaluation of their performance made by representatives of the cooperating agencies, using criteria devised by that group. Based on the group's evaluation and recommendations, requests for funding to implement other units would be made. At this time, it is not possible to determine how many additional units are feasible for implementation.

1.19 Public Access Features. One of the most recent controversies involved the proposed 1980 State of Louisiana public access proposal included in the draft plan. Public access was proposed over 23,000 acres of "greenbelts" in selected areas adjacent to lower basin navigable waterways and along the inside toe of perimeter guide levees. Hunting clubs were adamantly opposed to any such easements on their leases. The State of Louisiana proposed that the Federal Government relieve the landowners from liability for any accidents that might occur on lands upon which easements would be procured. Under law, the Federal Government cannot assume such liability. This issue has been resolved by the 1981 substitute real estate proposal which involves lands donated to the state and fee purchase from willing sellers.

Unresolved Issues

1.20 Although most of the controversial issues have been resolved to the extent necessary to allow preparation of this EIS, others remain unresolved. Four of these involve a difference in the respective agency policies and are discussed below.

1.21 Flood Protection for the Backwater Area Northeast of Morgan City. The method of protecting this area from backwater flooding has been an object of controversy. The US Environmental Protection Agency, US Fish and Wildlife Service, US National Marine Fisheries Service, and environmental groups feel that extension of the Avoca Island levee would cause severe environmental damage. The extent of such damage cannot, however, be quantified using the available data. This controversy has not been totally resolved by the recommendation to conduct additional detailed studies prior to implementing the best method for providing a solution to the backwater flooding problem.

1.22 Mitigation for Past Construction. Environmental interests and agencies argued early in the study for mitigation of damages resulting from past construction activities. US Army Corps of Engineers policy generally does not allow such mitigation. The plans presented in this EIS do not include mitigation for past construction in the Atchafalaya Basin.

1.23 Evaluation of Separable Project Features. Early in the study, there was concern among environmental groups that, via evaluation policy, the US Army Corps of Engineers was trying to circumvent fish and wildlife features of a multipurpose plan. Environmental groups felt that because a multipurpose plan would be tied to the Mississippi River and Tributaries (MR&T) project, any features of that plan should share in the benefit-to-cost ratio for the overall MR&T project. US Army Corps of Engineers policy dealing with the economic analysis of projects, however, dictates that each separable feature of a project must be evaluated independently, or in other words "stand on its own," based on monetary (tangible) and nonmonetary (intangible) benefits. Separable features, in this case, are those dealing primarily with nonflood control measures.

1.24 Implementation of a Single Multipurpose Plan. Throughout the study, there has been a concern among environmental groups that the previously authorized features of the final Recommended Plan would be implemented first and that new features, needing congressional authorization, might never be implemented due to their not being authorized or funded. This report recommends that all nonauthorized plan features be given an expeditious review so that completion of all previously authorized and newly authorized features will be carried out jointly to the maximum extent practicable. However, construction of those features previously mandated by the Congress will not be delayed pending authorization of additional features.

Relationship of Plan to Environmental Requirements

1.25 Table 1-1 indicates the relationship of each plan to Federal and state environmental protection statutes and other environmental requirements. A plan is listed as being in full compliance if at this stage of project planning, all necessary steps have been taken to comply with the statute in question.

TABLE 1-1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION
STATUTES OR OTHER ENVIRONMENTAL REQUIREMENTS
ATCHAFALAYA BASIN FLOODWAY, LOUISIANA

	Plan 4 EQ	Plan 7 NED	Plan 9 R
FEDERAL STATUTES			
1. Preservation of Historical Archeological Data Act of 1974. Compliance requires Corps to undertake recovery, protection, and preservation of significant cultural resources whenever its activities may cause irreparable loss or destruction of such resources. Coordination with Advisory Council and others required. Coordination of DEIS brought project into partial compliance.	PC	PC	PC
2. Clean Air Act, as Amended. Compliance requires coordination with the US Environmental Protection Agency. Coordination of DEIS brought project into full compliance.	FC	FC	FC
3. Clean Water Act of 1977. Compliance requires preparation of 404(b)(1) Evaluation and submission of such to Congress with FEIS or procurement of a State Water Quality Certificate. The latter course will be taken for certain authorized features.	FC	FC	FC
4. Coastal Zone Management Act of 1972, as Amended. Compliance requires coordination with the Louisiana Department of Natural Resources to insure consistency with provisions of the Act. A draft Consistency Determination was sent to the State with the DEIS and no comment was received. A final Consistency Determination will be provided to the State at the time the FEIS is provided.	FC	FC	FC
5. Endangered Species Act of 1973, as Amended. Compliance requires coordination with the US Fish and Wildlife Service and the National Marine Fisheries Service to determine if any endangered or threatened species or their critical habitat would be impacted by the project. See Appendix H for results.	FC	FC	FC
6. Estuary Protection Act. Compliance requires review and comment by Department of the Interior. Washington level review of FEIS will bring project into full compliance.	FC	FC	FC
7. Federal Water Project Recreation Act. Compliance requires review by Department of the Interior. Washington level review of FEIS will bring project in full compliance.	FC	FC	FC
8. Fish and Wildlife Coordination Act. Compliance requires coordination with the US Fish and Wildlife Service (FWS), National Marine Fisheries Service, and Louisiana Department of Wildlife and Fisheries. Agency recommendations are discussed in Section 8 of the FEIS and the Coordination Act Report of the FWS is part of Appendix I.	FC	FC	FC

TABLE 1-1 (Continued)

RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION
STATUTES OR OTHER ENVIRONMENTAL REQUIREMENTS
ATCHAFALAYA BASIN FLOODWAY, LOUISIANA

	Plan 4 EQ	Plan 7 NED	Plan 9 R
9. Land and Water Conservation Fund Act. Requirements similar to 7 above.	FC	FC	FC
10. Marine Protection Research and Sanctuaries Act of 1972, as Amended. Compliance requires evaluation of need for transport of dredged material for purposes of dumping it in ocean waters. No such action is anticipated in the project.	N/A	N/A	N/A
11. National Historic Preservation Act. Compliance requires Corps to take into account the impacts of project on any property included in or eligible for inclusion in the National Register of Historic Places.	PC	PC	PC
12. National Environmental Policy Act. Compliance requires preparation of this document. Completion of FEIS and signing of Record of Decision will bring project into full compliance.	FC	FC	FC
13. River and Harbor Act. No requirements for Corps projects authorized by Congress.	N/A	N/A	N/A
14. Watershed Protection and Flood Prevention Act. No requirements for Corps projects.	N/A	N/A	N/A
15. Wild and Scenic River Act. Compliance requires coordination with Department of the Interior to determine if any designated or potential wild, scenic, or recreational rivers are affected by project. Coordination has been accomplished and there are no such rivers in the project area.	FC	FC	FC
EXECUTIVE ORDERS			
1. Executive Order 11988, Floodplain Management. Compliance requires an assessment and evaluation together with the other general implementation procedures to be incorporated into the Main Report and noted in the DEIS.	FC	FC	FC
2. Executive Order 11990, Protection of Wetlands. Compliance requires results of analysis and findings related to wetlands be incorporated into Main Report and DEIS.	FC	FC	FC
3. Executive Order 12114, Environmental Effects Abroad of Major Federal Action. No requirements for Corps projects in US.	N/A	N/A	N/A

TABLE 1-1 (Continued)

RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION
STATUTES OR OTHER ENVIRONMENTAL REQUIREMENTS
ATCHAFALAYA BASIN FLOODWAY, LOUISIANA

	Plan 4 EQ	Plan 7 NED	Plan 9 R
4. Executive Memorandum, Analysis of Impacts on Prime and Unique Farmlands in EIS. Compliance requires inclusion in DEIS of effects of proposed action on prime and unique farmlands.	FC	FC	FC
5. Executive Order 11593, Protection and Enhancement of the Cultural Environment. Compliance requires Corps to administer cultural properties under their control in stewardship for future generations; preserve, restore or maintain such for benefit of the people; and to assure that its plans contribute to preservation and enhancement of non-Federally owned sites.	FC	FC	FC
STATE AND LOCAL POLICIES			
1. Air Control Law. Compliance requires consistency with the State of Louisiana Implementation Plan with the Federal Clean Air Act, as amended.	FC	FC	FC
2. Archaeological Treasure Act. Compliance requires a contract from the Louisiana Archaeological Survey and Antiquities Commission for excavation or removal of cultural resources which are located on state land.	FC	FC	FC
3. Historic Preservation District Act. This act does not apply to Federal agencies.	N/A	N/A	N/A
4. Louisiana Scenic Streams Act. Compliance requires coordination with Louisiana Department of Wildlife and Fisheries if action would adversely affect a Louisiana scenic stream. This project would not do so.	FC	FC	FC
5. Protection of Cypress Trees (EO 1980-3). Compliance requires protection of cypress growing in state-controlled waterways. Cutting is prohibited unless necessary to remove real or potential threats to human life or health or to protect public interest.	FC	FC	FC
6. Water Control Law. Compliance requires consistency with Water Quality Standards established by the State of Louisiana.	FC	FC	FC
7. Development of Atchafalaya River Basin Act (Act No. 612)[1] Compliance requires that consideration be given to acquisition of 50,000 acres in the Atchafalaya Basin Floodway as partial mitigation for recreation losses and damages to fish and wildlife habitat and resources.	FC	WNC	FC
8. Senate Concurrent Resolution No. 8 (1976)[1] Compliance requires that the Federal Government not expropriate privately-owned land within the Lower Atchafalaya Basin for environmental, esthetic, or recreational purposes.	WNC	WNC	WNC

TABLE 1-1 (Continued)

RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION
STATUTES OR OTHER ENVIRONMENTAL REQUIREMENTS
ATCHAFALAYA BASIN FLOODWAY, LOUISIANA

	Plan 4 EQ	Plan 7 NED	Plan 9 R
LAND USE PLANS			
1. Louisiana Coastal Zone Management Plan. Compliance requires that any Federal development project in the coastal zone of a state shall be conducted in a manner which is, to the maximum extent practicable, consistent with the approved state coastal zone management program. See Appendix G.	FC	FC	FC
2. Regional and Metropolitan Clearinghouses (OMB CIRCULAR A-95) Compliance requires coordination with all clearinghouses whose jurisdiction exists within the project area.	FC	FC	FC
REQUIRED FEDERAL ENTITLEMENTS			
None are required.			

FC = Full compliance - All requirements of regulations at this stage of planning have been met.
PC = Partial compliance.
WNC = Would not comply.
N/A = Not applicable.
DEIS = Draft Environmental Impact Statement.
FEIS = Final Environmental Impact Statement.

[1]Please note that the current State position with regard to real estate acquisition within the Atchafalaya Basin is reflected in the proposed state plan discussed elsewhere in this report.

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3. NEED FOR AND OBJECTIVES OF ACTION

Study Authority

3.1 This study resulted from three congressional authorities: an 11 June 1968 resolution by the Committee on Public Works of the US Senate for a study of the operation of the Old River project, and resolutions by both the US Senate and House Committees on Public Works, 23 March 1972 and 14 June 1972, respectively, to develop a comprehensive plan for the preservation and management of the water and land resources of the Atchafalaya Basin. (A quotation of these authorities may be found in Appendix A, Section 1). By letter dated 18 June 1976, the Director of Civil Works of the Office of the Chief of Engineers directed the President of the Mississippi River Commission to address both the previously authorized features of the Atchafalaya Basin Floodway project and potential features for resource preservation and management, effectively combining studies of the Atchafalaya Basin Floodway project with those previously mandated by Congress.

Public Concerns

3.2 Throughout the course of the study, informal and formal interchange between the participating agencies and the public has provided an insight into the area's water and related land resource problems and needs as perceived by the public. In all cases, concern was expressed regarding the inability of the floodway to pass the project flood to the gulf while protecting life and property adjacent to the floodway system, and it was urged that actions to accomplish this be completed with haste. The inability to pass the project flood developed because of a loss of flood-carrying capacity of the floodway due to subsidence (sinking) of the east and west protection levees, sediment deposition within the floodway proper, and the inadequacy of the present outlets to safely pass the volume of water necessary. Concern over protecting life and property adjacent to the floodway system arose because natural alluvial riverine processes active in the floodway and the development of the Atchafalaya delta south of Morgan City have caused a rise in water levels in the backwater area northeast of Morgan City that will continue into the future. This continuing rise in water levels subjects the inhabitants of this area to an increased flood hazard, and it could eventually lead to forced abandonment of existing homes, business enterprises, and farmland as well as have a harmful impact upon the timber resources of the area. The public also voiced concern regarding the state of environmental

resources within the study area and the potential for further widespread degradation. Various interest groups expressed a desire to alter the existing flow regulation at Old River. Some favored a preference for less flow down the Atchafalaya to enhance agriculture while others favored a preference for more flow to preserve, and possibly enhance, environmental values. A desire was also expressed that delta development in Atchafalaya Bay be maximized. Early in the study the potential for nonconsumptive recreation, as well as for hunting and fishing by the general public, was recognized by local, state, and national interest groups who expressed a desire for more public access to the basin's swamps and forests. All of these concerns were considered in identifying the water and related land resource management needs of the study.

Planning Goals and Objectives

3.3 These goals and objectives were developed by the Agency Management Group, consisting of the Corps, the US Environmental Protection Agency, the US Fish and Wildlife Service, and the State of Louisiana (represented by the Office of Public Works).

GOALS

3.4 Protect south Louisiana from Mississippi River and Tributaries floods.

3.5 Retain and restore the unique environmental features and long-term productivity of the natural environment of the basin.

OBJECTIVES

3.6 Flood Control - Implement a flood control system that will safely pass the project flood to the Gulf of Mexico in an environmentally sound manner. Reduce to the maximum extent practical the deposition of sediments that reduce the ability of the floodway to pass the project flood.

3.7 Natural Environment - Retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands.

3.8 Agricultural Activities and Mineral Development - Allow agricultural activities and mineral development, provided such activity does not interfere with the goals relative to flood control or the natural environment.

3.9 Delta Formation - Maximize natural delta formation in Atchafalaya Bay while providing for navigation and passage of the project flood.

3.10 Public Accessibility - Maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway.

4. ALTERNATIVES

4.1 The Atchafalaya Basin Floodway system, the backwater area east and northeast of Morgan City, and the coastal marshes form an exceedingly complex system. Because of this complexity, simple solutions to the problems of flood control and environmental preservation do not exist. To develop a multipurpose plan for this large and diverse area, existing project features and management options were separated into groups that addressed individual problems and opportunities. Then, alternative solutions or features were developed within each group, and subsequently, one or more features from each group were combined to form an individual plan. For purposes of illustration at the January 1979 public meetings, 10 comprehensive plans were presented to show the combinations that could be developed to emphasize different study goals. (Prior to these meetings, the US Fish and Wildlife Service proposed Federal purchase of 443,000 acres of land in the Lower Atchafalaya Basin Floodway so it could be used as a "Fish, Wildlife, and Multi-use Area.") As a result of comments at the meetings and subsequent studies, many features were eliminated while others were considered in detail. From the features considered in detail, the National Economic Development (NED), Environmental Quality (EQ), and the Recommended (R) Plans were chosen.

Description of Completed Features

4.2 Since the Atchafalaya Basin Floodway system is a partially completed project, it is necessary now and would be necessary in the future to operate and maintain the completed plan features as well as the new features proposed in the subsequent paragraphs. A brief description of the existing features of the system follows. For a more detailed description see Appendix A (major existing features are shown in Plate 1).

4.3 The Atchafalaya Basin Floodway system was constructed to safely convey floodwaters in excess of the capacity of the leveed Mississippi River to the Gulf of Mexico. For the project flood of 3,000,000 cubic feet per second (cfs), the floodway system would receive 620,000 cfs from the Mississippi River via the Old River control structure complex and 350,000 cfs from the Red River. The Morganza Floodway, with a gated control structure at its head, is 20 miles long and 5.5 miles wide and is located on the east side of the Atchafalaya River from Morganza to Krotz Springs. This floodway is designed to carry 600,000 cfs of the project flood entering from the Mississippi River. The West Atchafalaya Floodway, 35 miles long

and 7 miles wide, extends from Simmesport to Krotz Springs, and is designed to take 250,000 cfs of the 970,000 cfs that would pass into the Atchafalaya River above Simmesport. The Lower Atchafalaya Basin Floodway, extending from below Krotz Springs to Morgan City, is approximately 14 miles wide and 65 miles long, and is designed to handle the approximately 1,500,000 cfs of the project flood that would enter via the Atchafalaya River, and the Morganza and West Atchafalaya Floodways. The floodway system is presently capable of safely conveying only about 60 percent of a project design flood. Perpetual flowage easements were acquired on all lands within the West Atchafalaya and Morganza Floodways. These easements provide for full use of lands for flood control purposes. Owners retain the rights to farm and to harvest timber and minerals. Easements over the Morganza Floodway also prohibit human habitation. In the Lower Atchafalaya Basin Floodway, flowage easements have been acquired only where the owner made a claim upon the Government. The floodway system includes 449 miles of levees and floodwalls, and numerous control structures, culverts, channels, and pumping stations to improve both intercepted and interior drainage (Tables 4-1 and 4-2 and Plate 5). Barge and crew boat navigation is maintained in the main channel of the Atchafalaya River and along the Morgan City to Port Allen Alternate Route of the Gulf Intracoastal Waterway as well as along the landside Alternate Route. Four locks are part of this navigation system (Table 4-3). Small boat navigation is maintained along the east and west access and freshwater distribution channels.

4.4 The Old River control structure complex is normally operated to pass 30 percent of the combined flow of the Red and Mississippi Rivers down the Atchafalaya River on a daily basis. During floodflows, operation is as described in paragraph 4.3 above. On three occasions in the past, accidents have occurred in which runaway barges lodged in the structure and reduction of flows down the Atchafalaya River was required. In order to avoid such occurrences, a picket boat is continually stationed just upstream. This boat is in communication with all river traffic and would intercept any possible loose barges. A radar system is in the process of being placed into operation to keep even better track of any objects that might endanger the low sill structure. This structure was damaged by high water flows in 1973. Emergency repairs and rehabilitation work have restored a substantial degree of confidence in the structure; however, there is grave concern about its ability to handle abnormal or emergency conditions. An auxiliary structure is under construction and it will restore the ability of the Old River complex to safely handle emergency conditions.

4.5 Operation of the Morganza Floodway would inundate 70,000 acres of land. Frequency of operation is estimated to be once every 20 years on the average. The only use to date was in 1973. Operation of the West Atchafalaya Floodway is estimated to occur less frequently than once every 100 years on the average. Waters would enter this

TABLE 4-1

EXISTING PROJECT FEATURES
FEATURES TO RESTORE INTERCEPTED DRAINAGE

NAME	DESCRIPTION	DATE COMPLETED	MAINTENANCE RESPONSIBILITY	MAINTENANCE ACTIONS
Bayou des Glaises Diversion Channel and Improvement of State Canal and Bayou Roseau	5 miles of channel	1943	Local interests	Inspection and removal of debris, shoals, and sediment.
Bayou des Glaises Culvert	72-inch corrugated pipe culvert with flapgate and stilling basin	1939	Local interests	Inspection and removal of debris, erosion repair.
Bayou Darbonne Drainage Structure	Reinforced concrete box culvert 10 x 10 x 265 feet	1941	Corps of Engineers	Inspection, minor repairs, erosion repair.
Bayou Courtableau Drainage Structure and Channels	Reinforced concrete box culvert, 5 barrel with 5 mechanically-operated lift gates. 220 feet long. Inlet channel 1,800 feet long and oulet channel 23,500 feet long.	1956	Corps of Engineers	Periodic trial operation of gates. Removal trash and drift. Inspection and repair of structure or erosion.
Courtableau Diversion Channel and Control Structure	Reinforced concrete weirs of 482 feet and 517 feet with outlet channels.	1942	Corps of Engineers	Inspection and removal of trash and erosion repair.
Bayou Berard Drainage Canal	7-mile channel	1940	Local interests	Inspection and removal of debris and shoals. Erosion repair.
Channel Improvement Cypremort to Dauterive	14.3-mile channel	1941	Local interests	Inspection and removal of debris and shoals. Erosion repair.
Charenton Drainage Canal	7-mile channel	1948	Corps of Engineers	Inspection and removal of debris and shoals. Erosion repair.

TABLE 4-1 (Continued)

EXISTING PROJECT FEATURES
FEATURES TO RESTORE INTERCEPTED DRAINAGE

NAME	DESCRIPTION	DATE COMPLETED	MAINTENANCE RESPONSIBILITY	MAINTENANCE ACTIONS
Borrow pit enlargement Hamburg to Courtableau	35-mile channel	1939	-	None required.
Coulee Des Grues Culvert	8 x 8-foot barrel-gated structure	1954	Red River, Atchafalaya Bayou Boeuf Levee District	Debris removal, erosion repair, structure repair.
Lottie to Maringouin Borrow Pit Enlargement	20-mile channel	1940	-	None required.
Bayou Boeuf - Bayou Long Drainage Canal and Enlargement of Bayou Chene (Landside Route)	35-mile channel	1947	Corps of Engineers	Debris and shoal removal, erosion repair.
Interior Drainage West of Berwick	38 miles of canals, 3 drainage structures, 20 gated culverts, 1 inverted siphon and 10 pumping stations.	mid-1970's	Local interests	Inspection, minor repairs, removal of trash and drift. Painting, oiling, and greasing.

TABLE 4-2

EXISTING PROJECT FEATURES
OTHER CONTROL STRUCTURES

NAME	DESCRIPTION	DATE COMPLETED	MAINTENANCE RESPONSIBILITY	MAINTENANCE ACTIONS
Low Sill Control Structure	Reinforced concrete, 11 gate bars, 566 feet between abutments, vertical steel lift gates operated by gantry cranes. Inflow and outflow channels.	1960	Corps of Engineers	Bank erosion prevention in channels with riprap and articulated concrete mattress. Filling of possible scour holes. Ground maintenance consists of mowing of grass and trash removal, inspection of structures and any necessary repair. Painting, oiling, and greasing.
Overbank Control Structure	Reinforced concrete, 75 bays 3,356 feet between abutments. Flow only occurs during floods.	1959	Corps of Engineers	Prevention of bank erosion. Ground maintenance, inspection and necessary repair and painting, oiling, and greasing.
Morganza Combined Control Structure	Reinforced concrete, 125 gated openings, steel lift gates operated by gantry crane.	1954	Corps of Engineers	Inspection and necessary repair. Painting, oiling, and greasing. Ground maintenance.
Pointe Coupee Drainage Structure	Reinforced concrete, 2 manually operated steel lift gates.	1942	Corps of Engineers	Inspection and necessary repair. Painting, oiling, and greasing. Ground maintenance.
Charenton Floodgate	Reinforced concrete, 2 electrically operated steel sector gates.	1948	Corps of Engineers	Inspection and necessary repair. Painting, oiling, and greasing. Ground maintenance.
East and West Calumet Floodgates	Reinforced concrete, each 161 feet long, and 45 feet clear width with steel sector gates, motor driven.	1950	Corps of Engineers	Inspection and necessary repair. Painting, oiling, and greasing. Ground maintenance.

TABLE 4-3

EXISTING PROJECT FEATURES
LOCKS

NAME	DESCRIPTION	DATE COMPLETED	MAINTENANCE RESPONSIBILITY	MAINTENANCE ACTIONS
Old River Navigation Lock	75 feet x 1,200 feet	1962	Corps of Engineers	Routine painting, oiling, and greasing. Minor repairs yearly. Dewatered every 10-15 years for major repairs. Ground maintenance consists of mowing and trash removal.
Bayou Sorrel Lock	56 feet x 797 feet	1952	Corps of Engineers	Same as above.
Berwick Lock	45 feet x 300 feet	1941	Corps of Engineers	Same as above.
Bayou Boeuf Lock	75 feet x 1,156 feet	1955	Corps of Engineers	Same as above.

floodway by natural and artificial crevassing of the fuseplug levee at its head. Operation would inundate all or portions of 154,000 acres of land. Flows from the Morganza and West Atchafalaya Floodways ultimately pass through the Lower Atchafalaya Basin Floodway and to the Gulf of Mexico by the Lower Atchafalaya River and Wax Lake Outlet, a 16-mile channel built by the US Army Corps of Engineers in 1942.

4.6 Operation of features to restore intercepted drainage generally serve to convey the waters to the landside borrow pit and other channels. The operable structures in this system such as the Courtableau Structure, the Charenton and East and West Calumet Floodgates, and all locks are operated to pass water into the floodway during high water periods on the landside, and to pass waters from the floodway to the landside for low flow augmentation. Drainage facilities are operated to maintain pre-project conditions within the leveed area west of Berwick and in Morgan City.

4.7 Maintenance requirements for the Atchafalaya Basin Floodway system are as varied as the features which comprise the project. Maintenance dredging requirements are indicated in Table 4-4, which lists dredging frequency, average annual cubic yardage, and disposal areas. It can be seen that over 2,200,000 cubic yards (cy) are dredged annually. Maintenance actions are shown in Tables 4-1, 4-2, and 4-3. Grounds maintenance is conducted on 6,593 acres. Levee maintenance consists of grass mowing and removal of trash and debris over 24,780 acres of levee.

4.8 The remainder of this section describes the features eliminated from further study and the rationale for doing so; the conditions that are expected to occur in the absence of any Federal action to address the planning objectives; features considered in detail; and the plans formulated from features considered in detail, including implementation responsibilities and mitigation requirements. Table 4-7 shows the impacts of each detailed plan and the future without-project conditions on each significant resource of the project-affected area.

Features Eliminated from Study

4.9 The eliminated features are listed by group and are briefly described, and the rationale for elimination is presented. These features are described in more detail in Appendix B.

TABLE 4-4

MAINTENANCE DREDGING

Location	Dredging Frequency	Average Annual Yardage (C.Y.)	Location of Spoil Disposl Areas	Acreage and Habitat Type of Disposal Areas
Old River Lock Tailbay	Once every 10 years	7,000	Confined on north bank of channel	160 BLHW
Three Rivers (Mile 0 Atchafalaya River)	Annually	150,000	In deep water in Atchafalaya River	
McCrea Landing (Mile 12 Atchafalaya River)	Once every 15 years	23,000	Disposed in shallow water in Atchafalaya River along either side of dredged channel	
East Freshwater Distribution Channel	Once every 10 years	160,000	Confined on bank adjacent to waterway	300 CT 670 BLHW
East and West Access Channels	Once every 10 years	610,000	Confined on bank adjacent to waterway	470 ES 1700 BLHW
Below Bayou Sorrel (Alternate Route GIWW)	Annually	170,000	Confined on bank adjacent to waterway	400 CT
Sixmile Lake	Once every 5 years	480,000	Disposed in deep water in Atchafalaya River and contained sites on north bank	2500 ES
Berwick Bay Harbor	Annually	500,000	Disposed in deep water in Atchafalaya River	
Berwick Lock Forebay	Once every 2 years	70,000	In deep water on Atchafalaya River and adjacent to river bank below the forebay	60 ES

ES = Early successional bottomland hardwood
BLHW = Mid to late successional bottomland hardwood
CT = Cypress-tupelo

GROUP 1 - ALTERNATIVES FOR OPERATION OF THE OLD RIVER CONTROL STRUCTURE

Maintain 60/40 percent distribution of total flows between the Mississippi and Atchafalaya Rivers below Old River, respectively.

4.10 This feature was proposed as an environmental enhancement measure, but engineering studies indicated that such a distribution could not be stabilized. This feature could result in the Mississippi River changing its course, resulting in severe economic, environmental, and social consequences.

Operate the Old River control structure to keep water levels from rising above 35 feet National Geodetic Vertical Datum (NGVD)[1/] on the Black River at Acme, Louisiana, in the Red River backwater area, with head constraints.

4.11 This feature was proposed to enhance agricultural production in the Red River backwater area, but studies indicated that it could cause extensive environmental damage due to loss of wetlands and forestlands in both the Red River backwater area and in the Atchafalaya Basin Floodway. In addition, it would cause increased safety problems for Mississippi River navigation during high water.

Maintain 35 feet NGVD at Acme with no head constraints.

4.12 This feature was discarded for the reasons cited above, as well as for economic reasons because it would entail construction of a new control structure at Old River (in addition to the Auxiliary Structure).

GROUP II - ATCHAFALAYA BASIN MAIN CHANNEL DEVELOPMENT AND LEVEE RAISING ALTERNATIVES

Confined 100,000-square foot (sf) channel from head of Whiskey Bay Pilot Channel to Wax Lake Outlet, 80,000-sf to Stouts Pass.

4.13 Studies indicated that channel dredging to such a cross-sectional area and disposal of dredged material would adversely affect in excess of 20,000 acres of woodlands and wetlands. Other alternatives would result in fewer adverse impacts for comparative costs.

[1/] Unless noted otherwise, all elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD), formerly mean sea level.

Confined 80,000-sf channel from head of Whiskey Bay Pilot Channel to Stouts Pass.

4.14 A preliminary study furnished by the US Environmental Protection Agency indicated that an 80,000-sf channel might be the largest that would develop naturally. Subsequent studies have shown that the channel would enlarge naturally, over time, to 100,000 sf.

GROUP III - SEDIMENT CONTROL ALTERNATIVES

No action alternative.

4.15 This alternative was eliminated because it made no contribution to either flood control or environmental goals.

Enlargement of major distributary channels at their heads, to act as sediment traps.

4.16 Studies indicated that maintenance would require disposal of dredged material on 3,000 acres of forestland. Since such maintenance would be an annual event and since sediment traps would remove only sand which would mostly be deposited along existing natural levees and not in backswamp areas, it was felt that permanent loss of this land would outweigh the benefits to be gained.

GROUP IV - MANAGEMENT UNITS AND RELATED FEATURES

Introduction.

4.17 Natural processes and human actions have combined to produce 13 areas in the Lower Atchafalaya Basin Floodway that are hydrologically distinct (Figure 4-1). Conceptually the units would be designed so that: water regimes would mimic historical water overflow patterns; water movement would occur through the units; sediment movement and deposition in the units might be restricted; and nutrients and organic matter would be supplied to the estuarine areas downstream.

No action alternative.

4.18 This alternative was eliminated because studies indicated that construction of some management units could significantly enhance the aquatic environment.

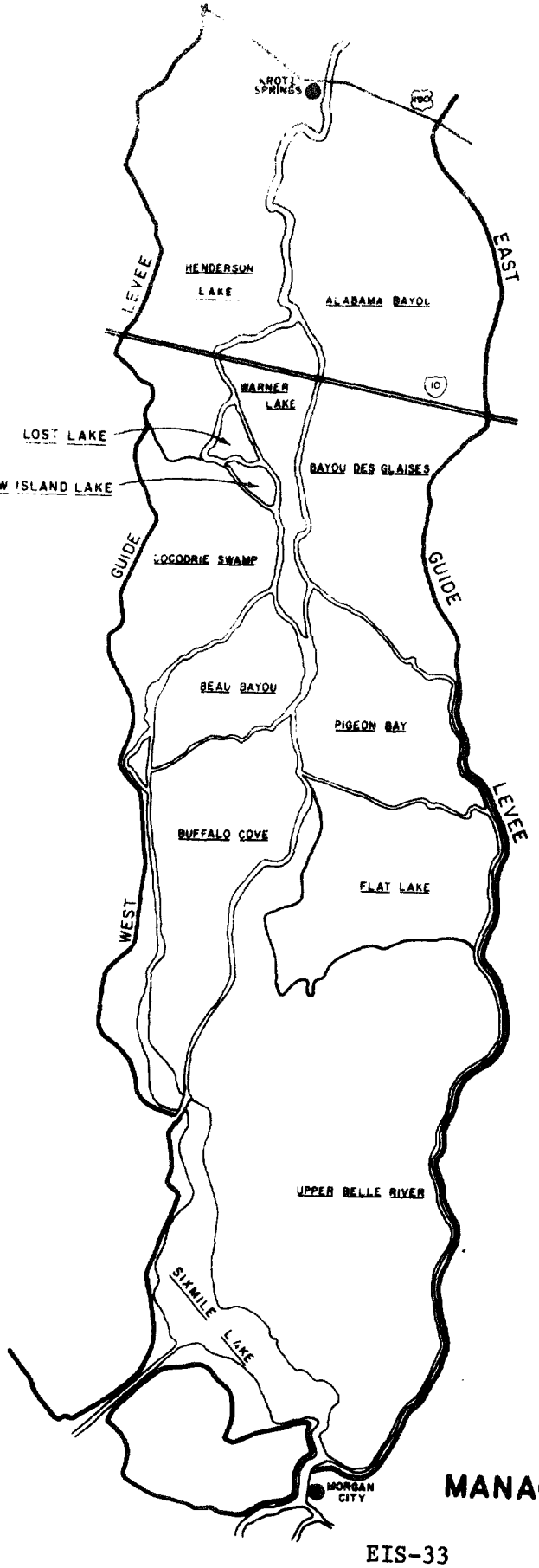


FIGURE 4-1

MANAGEMENT UNITS

Implementation of all 13 management units.

4.19 After evaluating the management unit concept, it was decided that a recommendation to implement all management units should not be made at this time since further studies are needed to determine exactly which units should be built to enhance environmental values.

GROUP V - ALTERNATIVE LAND-USE PLANS

4.20 No land-use plan alternatives were eliminated.

GROUP VI - ALTERNATIVES FOR FLOODWAY OUTLETS AND DELTA BUILDING

No action alternative.

4.21 This feature was eliminated because if nothing is done, the combined capacity of the outlets would continue to decrease; therefore, the project flood could not safely pass through the Teche Ridge.

Redistribute most flows to Wax Lake Outlet (Lower Atchafalaya River 0 percent/Wax Lake Outlet 100 percent).

4.22 Studies indicated that this feature would require two major navigation structures and, thus, would be inordinately costly. The long-term beneficial effects of such a redistribution on delta formation would not be of the order of magnitude to justify such costs and could disrupt existing environmental conditions to the east and west of Atchafalaya Bay.

GROUP VII - ALTERNATIVES TO REDUCE BACKWATER FLOODING EAST OF THE FLOODWAY

No action alternative.

4.23 This feature was eliminated because it would not protect the area from backwater flooding.

GROUP VIII - MANAGEMENT ENTITY

Introduction.

4.24 To insure proper implementation and operation of the plan selected, a management entity would be established. Mechanisms would

be included for public involvement. The management entity would not inhibit emergency flood control operations.

No action alternative.

4.25 Since the need for and makeup of a management entity could not be determined until a plan was selected, the no-action option was discarded.

Without-Project Conditions

4.26 If no Federal action were taken to address the planning objectives, the Atchafalaya River would persist in widening and deepening its channel, the Lower Atchafalaya Basin Floodway would continue to fill with sediment, clearing for agriculture and other development would rapidly accelerate, the Terrebonne Parish marshes would continue to deteriorate at an alarming rate, and water levels would continue to rise near Morgan City, in the Terrebonne marshes, and in the backwater area to the east and northeast. As the delta built in Atchafalaya Bay, the percent of flow between the outlets would stabilize at approximately 50 percent. Under future conditions, environmental quality would be drastically degraded and the threat of a severe flood affecting the urban and industrial areas south of Old River would be profoundly increased. In view of this latter fact, and because the basin is first and foremost a floodway, it was assumed that local interests would continue to raise the levees to preserve the flood-carrying capacity of the basin in the absence of any Federal action. (Future without-project conditions are more specifically described as they relate to each significant resource considered in Section 5 of this EIS, and are discussed in detail in Section 6 of Appendix A.)

4.27 Completion of levee raising by a non-Federal interest would cause forest, wetland, and aquatic habitat destruction and other environmental losses. (These losses are described in detail in Section 6 of the EIS and Section 6 of Appendix A.) In order to meet the legal requirements for identifying mitigation measures necessary to replace these losses, various habitat-based evaluation methods were utilized (these are described in Appendix G). These methods revealed the following losses in annualized habitat units: flooded forest, 3,016; bottomland forest - open land, 4,450; and cypress-tupelo swamp, 1,550. To mitigate for losses of flooded forest and cypress-tupelo swamp it would be possible to open the Wax Lake Outlet overbank area to allow the overflow flooding of 7,800 acres of hardwoods and swamp that is presently flooded only by local rainfall. To mitigate for loss of bottomland forest and open land, it would be possible to

purchase and manage about 12,000 acres of bottomland hardwood forest within the floodway.

Features Considered in Detail

4.28 Features carried forth into the final array of alternatives are described subsequently by group. For those features which were not made a part of the final three plans, a rationale for this elimination is provided. Additional information regarding final plan formulation may be seen in Appendix B.

GROUP I - ALTERNATIVES FOR OPERATION OF THE OLD RIVER CONTROL STRUCTURE

Maintain 70/30 percent distribution annually of total flows between the Mississippi and Atchafalaya Rivers below Old River, respectively with possible short-term variation of flow.

4.29 Various interest groups have expressed a desire to vary the present 70/30 daily distribution slightly during May, June, and July. Farmers in the Red River backwater area would benefit some years from a reduction in flow into the Atchafalaya River so that stages would not rise above 45 feet at Acme. However, the US Fish and Wildlife Service would like to see flows increased in some drier years to benefit fishery resources in the lower floodway. This alternative was eliminated because the economic gains that would be achieved in the backwater area by reducing flows into the Atchafalaya River would be far outweighed by environmental and economic losses sustained in the backwater area and the lower basin. Additionally, engineering studies have shown that increasing flows into the Atchafalaya River could lead to the capture of the Mississippi by the Atchafalaya.

Maintain 70/30 percent distribution of total flows between the Mississippi and Atchafalaya Rivers below Old River, respectively on an annual basis.

4.30 This is the present operational scheme and it would be maintained in the future.

GROUP II - ATCHAFALAYA RIVER MAIN CHANNEL DEVELOPMENT AND LEVEE RAISING ALTERNATIVES

Raising of the East and West Atchafalaya Basin Protection Levees, Atchafalaya River Levees, and levees West of Berwick.

4.31 Levee raising has been a continuing process since 1972. These levees would need to be raised approximately 6 feet in the southern portion and approximately 4 feet in the northern portion (Plate 5). Maintenance would consist of grass mowing, road repairs and other minor actions. Certain existing locks, floodgates, drainage structures, culverts, pumping plants, and service roads would also need to be modified to pass the project flood. These are listed in detail in the main report.

Channel training alternative.

4.32 Reduction of sediment deposition in overbank areas would be accomplished by dredging 29,000,000 cy of material from the river and depositing it on the banks to confine flows and sediment. These new banks would initially cover approximately 6,000 acres from river mile 90 to mile 116 (Plate 6). Low back levees would prevent runoff of sediment into adjacent areas. There would be no gaps in the banks, and they would be built to a height that would be overtopped during 50 percent of the years of project life. Future bank maintenance from mile 53 to mile 90 could become necessary if severe bank erosion occurred in this reach and repairs were needed to confine the river. Maintenance of training works would be minimal and would be limited to repair of any crevasses which might occur during major floods.

Modified channel development.

4.33 Approximately 32,800,000 cy would be dredged from the main channel between mile 101 and mile 114 and the dredged material placed upon the adjacent banks. No gaps would be left in the banks and approximately 7,000 acres would be covered by dredged materials. Maintenance would consist of repair of crevasses. This alternative was eventually dropped due to its cost and because it would be no more effective in reducing overbank sedimentation than the channel training alternative described above.

100,000-sf channel from head of Whiskey Bay Pilot Channel to Wax Lake Outlet, 80,000-sf to Stouts Pass, with gaps.

4.34 The river would be dredged and the dredged material would be placed on approximately 20,000 acres of adjacent banks and forests with gaps left to allow flow into the swamps, bayous, and lakes. This alternative was dropped because of its adverse environmental impact and high cost.

Bank Stabilization.

4.35 The banks of the Red and the Atchafalaya Rivers would be stabilized where necessary by placement of riprap or articulated concrete mattresses from the Old River outflow channel to the head of Whiskey Bay Pilot Channel (Plates 13-17). A 1.4-mile revetment would be built at Morgan City. (Approximately 41 miles of revetments are already constructed and nearly 24 miles remain to be built.) Maintenance would consist of repair of any damages that might occur.

GROUP III - SEDIMENT CONTROL ALTERNATIVES

Distributary channel realinements.

4.36 The major distributary channels of the Atchafalaya Basin main channel (Old Atchafalaya River, east and west access and east freshwater distribution channels) would be realined to reduce the entrance angle to between 30 and 45 degrees to reduce the volume of sediments being carried by these channels into swamp areas. This would be accomplished by blocking the distributary near the main channel, while at the same time dredging and placing necessary revetments for a new entrance channel (Plate 7). Maintenance would consist of regular inspection and repair of eroded areas which might be formed.

GROUP IV - MANAGEMENT UNITS AND RELATED FEATURES

Phased implementation.

4.37 This feature would provide for the implementation of two pilot management units and, based on detailed studies of the results of their operation, the development of others. Development of management units would require restriction of their natural outlets by constructing weirs and, in some cases, low-level levees (Plate 11). Construction of new inlets at the upper end of management units would probably be necessary, as well as the closure of certain bayous and canals, and the improvement of water circulation within the units. Rollovers for small boat access would be installed at some bayou and canal closures. Maintenance would consist of trash and debris removal from inlets and outlets, any necessary levee repairs, and boat rollover maintenance.

4.38 Studies to date indicate that five units--Buffalo Cove, Henderson, Beau Bayou, Flat Lake, and Cocodrie Swamp--have the greatest potential for accomplishing the goal of restoring historical overflow conditions to benefit the aquatic ecosystem. These five were specifically included in the plan and the costs, benefits, and impacts

developed for plan evaluation purposes (Figure 4-2). The Buffalo Cove and Henderson units are proposed for initial implementation as pilot units. Subsequent to their construction, they would be monitored by representatives of the cooperating agencies, using criteria developed by that group, and an evaluation of their performance would be made. Based on that group's evaluation, and recommendations, requests for funding of other units would be made. At this time, it is not possible to determine, with any precision, exactly how many additional units could be recommended for implementation.

Freshwater structures.

4.39 A freshwater diversion structure near Krotz Springs would serve as an inlet for the Henderson Management Unit. This structure would be a gated culvert designed to pass a maximum of about 3,000 cfs into the upper regions of the Henderson area. The exact location of this structure has not yet been determined, as several feasible sites exist. Studies to date, however, have ruled out the use of Indian Bayou and Bayou Courtableau where they meet the Atchafalaya River. The most likely site presently seems to be Big Bayou Graw near river mile 45. Future studies, during advanced stages of planning, would finalize the location of the structure. Plans would also be developed to insure that diversion of river water does not increase flooding on existing developed land or farmland in the vicinity of the structure nor cause a deterioration in the existing water quality of the presently impounded reach of lower Bayou Courtableau.

4.40 The Sherburne Freshwater Diversion Structure at river mile 43 would provide freshwater to the Alabama Bayou area. This gated culvert would pass a maximum of about 3,000 cfs into Big Alabama Bayou.

4.41 Maintenance of both structures would consist of periodic inspection, removal of accumulated debris, and any repairs needed.

Canal closures and circulation improvements.

4.42 This feature would consist of closing certain canals that permit sediment-laden waters to enter backswamp areas, and of improving water circulation throughout the lower floodway by selective opening of dredged material banks and other features which presently impede circulation.

GROUP V - ALTERNATIVE LAND USE PLANS

Introduction.

4.43 The real estate features of the plans provide for those interests needed to serve three basic functions: flood control,

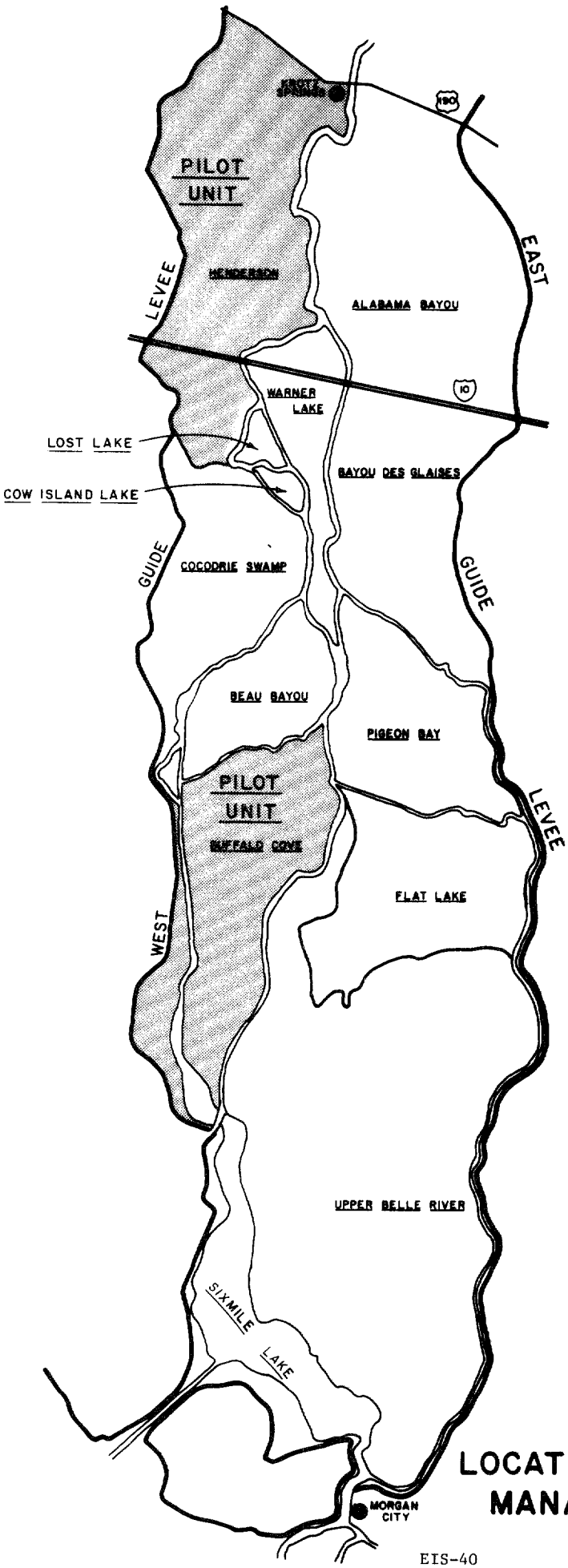


FIGURE 4-2
LOCATION OF PROPOSED
MANAGEMENT UNITS

environmental protection, and public access. Real estate features for both flood control and environmental purposes were developed in specific response to study objectives cited by the authorizing congressional resolutions. The public access function is ancillary to the proposed environmental features of the project. The state expressed the view that public access in addition to the current state-owned lands was desirable. Both of the proposed public access interests were developed in accordance with the recommendations of the Governor. For all new real estate interests acquired for project purposes, mineral rights would be retained by the landowner.

Flood control.

4.44 The Flood Control Act of 1936 specified: "That no flowage easements shall be paid for by the United States over properties subject to frequent overflow in the Atchafalaya Basin below the approximate latitude of Krotz Springs." It was determined that about 68,000 acres were subject to purchase of such flowage easements. To date, those easements have been obtained on about 9,000 acres. Flowage rights are proposed to be purchased on the remaining 59,000 acres. In addition, the right to prohibit the construction of new permanently habitable structures and to prohibit or regulate construction of other structures, including camps, would be acquired over all privately-owned land in the lower basin, except for developed ridges. Equivalent interests would be obtained from the State of Louisiana on all state-owned lands. The need for developmental control is associated with operation of the floodway. This right would assure the lower floodway's readiness for operation on short notice, preclude the need for US Army Corps of Engineers emergency flood-fighting operations and associated Federal expenses within the basin, and insure no liability on the part of the Federal Government for the public health, safety, and welfare by controlling industrial development that could prove hazardous to the public during floodway operations.

Environmental protection.

4.45 Certain rights are considered necessary for preservation of fish and wildlife habitat and maintaining the "wet and wild" environmental appeal of the lower floodway. Such rights would include control over all excavation and landfill operations, and provisions to allow for extension of the time and duration of flooding by natural or artificial means. Land conversion control would prohibit clearing of forests for the purpose of agricultural production or other pursuits such as industrial development. Control over timber would preserve habitat by requiring sustained yield forestry practices. A comprehensive multipurpose easement, or higher interest if mutually agreed upon, containing the cited environmental interests would be acquired over all privately-owned land in the lower basin except for the developed ridges. Equivalent interests would be obtained from the State of Louisiana on all state-owned lands.

Public Access.

1980 State of Louisiana proposal.

4.46 The public access function proposed at the July 1981 public meetings was subdivided into two basic categories: recreational development and general public access. For the recreational development feature, a total of 1,500 acres would be acquired in fee title in the proximity of the lower floodway to provide for the development of destination and primitive campsites, boat-launching ramps and other facilities complementary to destination-type outdoor recreational activities. The general public access feature would be accomplished by the acquisition of such additional rights on 103,500 acres of the same acreage previously cited for environmental protection easements. The public access areas would include 30,000 acres of late successional bottomland hardwood forests, 50,000 acres of cypress-tupelo swamps, 23,000 acres of greenbelts along the edges of selected navigable public waterways and sites along the interior toe of the basin protection levees, and 500 acres of existing rookeries. Additional rights to prohibit harvest of timber would be obtained on 73,500 of the same acres over which general public access easements were acquired; only 30,000 acres of cypress-tupelo would be excepted.

Development of substitute proposal.

4.47 During the public meetings of July 1981, general opposition was expressed to the greenbelt portion of the plan by landowners and hunters, while the greenbelts were generally favored by environmental interests. Additionally, landowners voiced opposition to the public access easements and originated an alternate proposition whereby the state would be offered certain lands for acquisition on a "willing seller" basis. These lands, plus those included in a recent donation to the state by the Dow Chemical Company, were proposed as a substitute for the public access easements cited above. The comprehensive multipurpose easement proposed for flood control and environmental protection over the entire Lower Atchafalaya Basin Floodway was generally supported by landowners and environmental groups and remained as part of the landowners' alternative proposal.

4.48 Subsequent to the July meetings, a compromise proposal for public access was developed through the cooperative efforts of major opposing interests. Prominent national and local environmental organizations worked with representatives of the landowners and the state toward this end. A key element of the new proposal which makes it acceptable to the environmental community is a recommended tightening of provisions of the comprehensive multipurpose easement to prohibit land-use conversion. A key issue resolved by the new proposal is the elimination of the "greenbelts" included under the prior public access proposal. The details of the new alternative for public access were announced by Governor David C. Treen during a press

conference on 19 November 1981, as a substitute for the public access provisions he had recommended in November 1980.

Recommended substitute proposal.

4.49 Recreational development would be as described in the 1980 proposal with the exception that some of the 200-500 acres specified in that proposal as special and unique areas would be set aside for rookeries. The general public access feature would be accomplished by the following described state-managed lands. At least 30,000 acres have been made available in the Lower Atchafalaya Basin Floodway through a donation of lands to the state made by the Dow Chemical Company. (An additional 10,000 acres near the floodway were also donated.) The state would provide additional public access on the 150,000 acres existing state-owned land and approximately 50,000 additional acres in the floodway would be made available by fee title acquisition from landowners identified by the state as willing sellers. Federal cost-sharing with the state would be recommended for the lands to be procured in an amount equivalent to that proposed in the draft plan for Federal acquisition of public access easement rights.

4.50 The exact habitat type composition of these lands is not known; however, for purposes of impact assessment it is assumed that 48,000 acres are mid-to-late successional bottomland hardwoods, 18,000 acres are early successional bottomland hardwoods, and 12,000 acres are cypress-tupelo.

Operation and maintenance of real estate features.

4.51 Operation and maintenance would consist of policing easements for unauthorized uses and managing lands for recreation, commercial fishing, wetland conservation, and oil and gas exploration.

No action.

4.52 This alternative was eventually dropped when it became obvious that real estate interests were needed for flood control, environmental protection, and public access.

GROUP VI - ALTERNATIVE FOR FLOODWAY OUTLETS AND DELTA BUILDING

Maintain existing flow distribution (Lower Atchafalaya River 70 Percent/Wax Lake Outlet 30 percent).

4.53 A weir and low-level levee would be constructed upstream of Wax Lake Outlet to maintain the existing distribution of outlet flows (Plate 8). Maintenance would consist of levee and weir repairs and mowing of grass.

Maintain 70/30 flow distribution with possible future change to approximately 20/80 percent distribution of outlet flows.

4.54 At first, present flows (70/30) would be maintained by a weir and low-level levee upstream of Wax Lake Outlet. If the estuarine and marsh ecosystem responded favorably, flows into Wax Lake Outlet would be further restricted by modification of the weir to limit the low to normal flows to 20 percent. Maintenance would be as described for the 70/30 alternative.

Close Wax Lake Outlet to normal flows (Lower Atchafalaya River 100 percent/Wax Lake Outlet 0 percent).

4.55 A low-level levee would be constructed at the head of Grand Lake. This levee would be overtopped by floodflows occurring on the average of once every 2 years. Maintenance would be as described for the 70/30 alternative.

Widen Wax Lake Outlet Overbank.

4.56 A new levee would be built west of the existing levee along the west side of Wax Lake Outlet to form a new overbank outlet. Existing levees within the widened overbank area would be degraded to ground level and a new West Calumet floodgate would be built (Plate 9). Maintenance would consist of routine levee repair and mowing of grass.

Training works below Morgan City.

4.57 This feature would provide for training works below Morgan City on both the Wax Lake Outlet and the Lower Atchafalaya River and a closure of Bayou Shaffer. Construction of the training works would require the dredging of approximately 15 miles of existing channel bottom areas and placing the dredged material in adjacent shallow water bottoms or on adjacent stream banks to confine average annual peak flows, leaving gaps between disposal areas to allow for continued development of the overbank marshes, for navigation access, and for pipelines (Plate 18).

Increase sediment through Wax Lake Outlet.

4.58 This feature would consist of dredging a new entrance channel to Wax Lake Outlet from the Atchafalaya River at an angle that would optimize sediment transport to the Wax Lake Outlet (Plate 12). Maintenance would consist of periodic inspection and repair of eroded channel areas. For engineering reasons, this feature could be built only if a 70/30 flow distribution were maintained at the outlets.

GROUP VII - ALTERNATIVES TO REDUCE BACKWATER FLOOD DAMAGES EAST OF THE FLOODWAY

Limited structural measures.

4.59 This feature would include building ring levees around Morgan City and other developed areas (Plates 23, 24, and 25), or a low-lying levee to the southwest of Houma. Providing additional pumping capacity, flood-proofing some structures, relocating some residences and businesses, and purchase of easements to prevent future development in the unprotected flood plain would also be accomplished. Maintenance would consist of periodic inspection and levee repair, mowing of grass, and trash removal. This feature was eliminated because of uncertainty over just what would be the best solution to the problem of backwater flooding and because of a need to accomplish more detailed studies before making a final decision.

Extension of the Avoca Island levee.

4.60 Approximately 14,000 feet of levee extension would be proposed for construction. (Impacts, costs, and benefits have been estimated for an entire levee extension only as a basis for equally comparing the detailed plans.) One proposed alinement would parallel the eastern shore of Atchafalaya Bay while the other proposed alinement would pass through the center of the bay (Plate 10). The bayshore alinement would include a navigation structure to connect the Avoca Island Cutoff to the Lower Atchafalaya River. Both alinements would also include water diversion structure(s) to be operated to maintain the present nonflood season distribution of water into the Terrebonne Parish marshes (Plate 10). During construction of the 14,000-foot first reach, detailed studies would be conducted to determine if construction of the remaining reaches is justified, or if some other alternative to solve flooding problems in the backwater area would be preferable. Any needed mitigation measures to compensate for environmental losses caused by these remaining reaches would also be clearly identified. Maintenance would be as described for the limited structural measures.

Delayed Action.

4.61 A decision on a recommendation for reducing backwater flood damages east of the floodway would be postponed until 1985. Recent refinement of hydraulic data has shown that implementation of other proposed project features common to all plans would help reduce flood damages for major floods with an expected frequency of occurrence of less than once in 10 years. Detailed studies would be conducted in the next few years to further evaluate extension of the Avoca Island levee and other structural and nonstructural features associated with means of reducing flooding problems in this area. Once these studies

were completed, a decision would be made as to which alternative would be implemented and a supplemental EIS would be prepared.

GROUP VIII - MANAGEMENT ENTITY

4.62 The management entity would depend on the features contained in the specific plan being considered.

Final Array of Plans

4.63 The EQ plan, the NED plan, and the Recommended Plan were formulated from the previously discussed features considered in detail. Table 4-5 lists the features of each of these plans, as well as the future without-project condition. The features of the Recommended Plan are shown on Plate 19.

MITIGATION NEEDS OF PLANS CONSIDERED IN DETAIL

4.64 No mitigation needs would exist with the EQ plan because implementation would result in a net gain of over 40,000 annualized habitat units (AHU's) of bottomland hardwood-open land habitat and almost 3,000 AHU's of swamp habitat. These gains would offset the small loss of 200 AHU's of marsh habitat this plan would cause.

4.65 Mitigation needs of the NED plan would require the replacement of about 6,400 AHU's of bottomland hardwood-open land habitat, about 3,000 AHU's of marshland habitat (19,200 units if the entire Avoca Island levee were built), about 8,500 AHU's of flooded forest and 11,100 AHU's of swamp habitat. To mitigate for loss of bottomland hardwood-open land habitat, it is proposed that about 16,800 acres of bottomland hardwood habitat would be acquired in fee and transferred to the Louisiana Department of Wildlife and Fisheries for use as a wildlife management area. It is assumed that such lands would be acquired within the Atchafalaya Basin Floodway and that they would be managed to increase their productivity for wildlife. To mitigate the loss of flooded forest and swamp it is assumed that management units would benefit aquatic productivity, and it is proposed that the Buffalo Cove Management Unit would be implemented to partially mitigate such a loss by preserving 8,200 AHU's of flooded forest and 4,000 AHU's of swamp. To mitigate for the remaining swamp losses, it is proposed that a water diversion structure would be built which would divert Mississippi River water into existing swampland in

TABLE 4-5
FEATURES OF FINAL ARRAY OF PLANS AND
THE FUTURE WITHOUT-PROJECT CONDITION [1/]

	FWO[2/]	EQ[3/]	NED[4/]	R[5/]
*70/30 flow at Old River	X	X	X	X
*Levee raising	X	X	X	X
*Bank stabilization		X	X	X
**Channel training		X	X	X
*Minor project features		X	X	X
**Sediment control (realinement)		X	X	X
Management units		X		X
**Freshwater structures		X		X
Canal closures and circulation improvements		X	X	X
Flood control easements[6/]		X	X	X
Environmental easements		X		X
Recreational development[7/]		X	X	X
1980 State of Louisiana public access		X		
Substitute proposal for public access				X
**LAR 100/WLO 0[8/]			X	
**LAR 70/WLO 30 to LAR 80/WLO 20				X
**LAR 70/WLO 30		X		
**Widen WLO Overbank		X	X	X
**Channel training below Morgan City			X	X
Increase sediment out WLO		X		
**Avoca Island levee 14,000-foot extension (channel)			X	
**Backwater flooding solution (delay in implementation)		X		X
Management entity		X	X	X
Swamp management via freshwater diversion			X	
Marsh management via freshwater diversion			X	
Land acquisition and management for mitigation	X		X	

[1/] Features requiring congressional authorization have no asterisk.
*Features currently authorized by Congress and approved by the Chief of Engineers.
**Features for which approval of the Chief of Engineers would be needed
[2/] Future without-project condition.
[3/] Environmental Quality.
[4/] National Economic Development.
[5/] Recommended Plan.
[6/] Acquisition of overflow rights to limited areas is authorized.
[7/] Boat-launching facilities are authorized.
[8/] LAR-Lower Atchafalaya River, WLO-Wax Lake Outlet.

the upper Barataria Basin. To mitigate for marsh losses, marsh management by freshwater introduction over 15,000 acres would replace losses caused by the first extension of the Avoca Island levee. Replacement of losses due to the entire levee would require management of over 100,000 acres.

4.66 The Recommended Plan includes the acquisition of real estate interests on 367,000 acres for the purposes of, among other things, preventing land clearing, preventing conversion of wetlands and woodlands to agriculture, and providing for the operation of management units. Public access to and ownership of the timber resources on 78,000 acres are also included. While it is recognized that some losses to environmental values would occur due to construction of various project features, it is considered that the need to mitigate these losses, in kind, would be negated by the overall positive environmental contribution of the real estate features of this plan.

4.67 Mitigation of losses to cultural resources cannot be determined until intensive cultural resource surveys on all features of the Recommended Plan are completed.

IMPLEMENTATION RESPONSIBILITY

4.68 Cost apportionment is shown in Table 4-6. As noted in the table, costs are apportioned using three cost-sharing policies: that proposed by President Carter in his June 1978 Water Policy Message to Congress; the Water Resources Council's traditional cost-sharing; and the policy proposed by the New Orleans District for this project.

4.69 Since it is an integral part of a project that provides drainage for one-third of the continental United States, the Atchafalaya Basin Floodway is a flood control project that goes far beyond local scope. The basin has national prominence as one of the largest river swamps in the nation remaining in a semi-natural state. Facilities may become authorized to satisfy the intent of the study authority, which directs preservation of the basin's natural resources, including improvements for sport and commercial fishing. It is proposed that the State of Louisiana take full responsibility for operation and maintenance of the management units, recreational developments, and lands acquired for public access. Flood control features, dredge and fill permits, and real estate management programs would remain under control of the New Orleans District.

TABLE 4-6

IMPLEMENTATION RESPONSIBILITY COST APPORTIONMENT

	PLAN		
	EQ	NED[1/]	R
	($)	($)	($)
PRESIDENT'S POLICY			
Federal first cost	699,541,000	697,304,000	678,771,000
Non-Federal first cost	316,300,000	240,577,000	309,235,000
Federal annual O&M	0	26,000	0
Non-Federal annual O&M	14,872,000	15,030,000	16,039,000
TRADITIONAL POLICY			
Federal first cost	954,140,000	927,703,000	924,976,000
Non-Federal first cost	61,701,000	10,178,000	63,030,000
Federal annual O&M	14,439,000	14,673,000	15,606,000
Non-Federal annual O&M	433,000	383,000	438,000
PROPOSED POLICY			
Federal first cost	999,903,000	936,006,000	936,797,000
Non-Federal first cost	15,938,000	1,875,000	51,209,000
Federal annual O&M	14,439,000	14,673,000	15,606,000
Non-Federal annual O&M	433,000	383,000	433,000

[1/] Based on construction of an additional 14,000 feet of the Avoca Island levee.

Comparative Impacts of Alternatives

4.70 Table 4-7 compares the base and without-project conditions and lists the impacts of each detailed plan on the significant resources of the project-affected area. Plan economic characteristics are also compared. The significant resources are individually described in Section 5 of this EIS, and the impacts of each plan on each significant resource are detailed in Section 6.

4.71 The impacts in this table are based on the assumption that in the NED plan alone the entire Avoca Island levee would eventually be built. Thus, all beneficial and adverse impacts of the entire levee are discussed. It is also assumed where appropriate that five management units would be built. No impacts of possible measures which might eventually be recommended to solve backwater flooding problems in the area northeast of Morgan City are discussed for the EQ and Recommended Plans. These impacts would eventually be discussed in a future supplemental EIS.

4.72 Definitions of the abbreviations that appear in the table are as follows:

DO = Dissolved oxygen
EQ = Environmental Quality Plan
FWO = Future without-project condition
LABF = Lower Atchafalaya Basin Floodway
LAR = Lower Atchafalaya River
MSY = Maximum sustainable yield
MU = Management units
NED = National Economic Development Plan
R = Recommended Plan
WLO = Wax Lake Outlet

TABLE 4-7

COMPARATIVE IMPACTS OF ALTERNATIVES

	EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS	LATE SUCCESSIONAL BOTTOMLAND HARDWOODS
Base	93,900 acres	332,000 acres
FWO	35,200 acres in 2030 Bulk of 58,700-acre loss due to clearing for agriculture.	186,100 acres 145,900-acre loss mostly due to land clearing for agriculture.
Plan 4 EQ	58,500 acres in 2030 35,400-acre loss from base mostly due to plant succession. 23,300-acre gain over FWO.	339,300 acres in 2030 153,200-acre gain over FWO due to environmental easements.
Plan 7 NED	42,100 acres in 2030 51,800-acre loss from base mostly due to land clearing. 6,900-acre gain over FWO.	177,700 acres in 2030 154,000-acre loss from base mostly due to land clearing. 8,400-acre loss from FWO due to land clearing.
Plan 9 R	60,400 acres in 2030 33,500-acre loss from base mostly due to plant succession. 25,200-acre gain over FWO.	339,500 acres in 2030 Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	CYPRESS TUPELO SWAMPS	AGRICULTURAL LAND
Base	451,000 acres	97,200 acres
FWO	415,000 acres in 2030 36,000-acre loss mostly due to land clearing.	283,800 acres in 2030 186,600-acre gain mostly due to land clearing.
Plan 4 EQ	408,200 acres in 2030 42,800-acre loss from base mostly due to plant succession. 6,800-acre loss from FWO mostly due to plant succession.	100,100 acres in 2030 2,900-acre gain over base due mostly to levee construction. 183,700-acre loss from FWO.
Plan 7 NED	364,100 acres in 2030 87,900-acre loss from base due to land clearing and plant succession. 50,900-acre loss from FWO mostly due to land clearing and plant succession.	326,500 acres in 2030 229,300-acre gain over base due mostly to land clearing. 42,700-acre gain over FWO.
Plan 9 R	407,700 acres in 2030 Impacts similar to those of Plan 4.	100,300 acres in 2030 Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	FRESH MARSH	BRACKISH MARSH	SALINE MARSH
Base	321,300 acres	89,000 acres	107,300 acres
FWO	243,100 acres in 2030 78,200-acre loss due mostly to existing marsh deterioration trends.	64,400 acres in 2030 24,600-acre loss due to marsh deterioration.	69,300 acres in 2030 38,000-acre loss due to marsh deterioration.
Plan 4 EQ	242,900 acres in 2030 78,500-acre loss from base. 300-acre loss from FWO due to direct construction impacts.	64,400 acres in 2030 24,600-acre loss over base due to marsh deterioration. No change from FWO.	69,300 acres in 2030 38,000-acre loss from base due to marsh deterioration. No change from FWO.
Plan 7 NED	238,500 acres in 2030 82,800-acre loss from base. 46,000-acre loss from FWO, mostly due to accelerated marsh loss caused by Avoca Island levee.	63,200 acres in 2030 25,800-acre loss over base. 1,200-acre loss over FWO, Avoca Island levee causes accelerated marsh loss.	69,200 acres in 2030 38,100-acre loss from base. 100-acre loss from FWO due to accelerated marsh loss caused by Avoca Island levee.
Plan 9 R	242,100 acres in 2030 79,200-acre loss from base. 1,000-acre loss from FWO, mostly due to direct construction impacts of channel training below Morgan City.	64,400 acres in 2030 Impacts similar to Plan 4.	69,300 acres in 2030 Impacts similar to Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	DELTA	RIVER, MAJOR DISTRIBUTARY, AND MAIN STEM LAKES	FRESH BAYOUS, CANALS, AND BORROW PITS
Base	10,100 acres	31,100 acres	38,000 acres
FWO	135,000 acres in 2030 125,000-acre gain due to delta development in Atchafalaya Bay.	32,100 acres in 2030 1,000-acre gain over base due to erosion of Atchafalaya River.	50,900 acres in 2030 13,000-acre gain due mostly to levee raising and some to marsh deterioration.
Plan 4 EQ	130,700 acres in 2030 124,600-acre gain over base. Same as FWO.	33,100 acres in 2030 2,000-acre gain over base due to construction and erosion. 1,000-acre gain over FWO due to construction.	50,900 acres in 2030 13,000-acre gain over base mostly due to levee raising and some to marsh deterioration. 100-acre gain over FWO due to construction impacts.
Plan 7 NED	130,700 acres in 2030 120,600-acre gain over base. 4,300-acre loss from FWO due to Avoca Island levee. Between 2030 and 2080 an additional 17,000 acres of delta would deteriorate due to the Avoca Island levee.	32,100 acres in 2030 1,000-acre gain from base due to erosion. Same as FWO.	52,100 acres in 2030 14,100-acre gain over base due mostly to levee raising and some to marsh deterioration. 1,200-acre gain over FWO due to construction impacts of the Avoca Island levee extension.
Plan 9 R	135,000 acres in 2030 Impacts similar to Plan 4.	32,300 acres in 2030 1,000-acre gain from base due to erosion. 200-acre gain from FWO due to construction.	50,400 acres in 2030 12,400-acre gain over base due mostly to levee raising and some to marsh deterioration. 500-acre loss over FWO due to fewer construction impacts.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	HEADWATER LAKES	BACKWATER LAKES	CROPLAND LAKES
Base	18,200 acres	42,000 acres	30 acres
FWO	1,900 acres in 2030 16,300-acre loss due mostly to sedimentation and lowering of water levels.	34,000 acres in 2030 8,000-acre loss due mostly to sedimentation and falling water levels and 3,900 acres reclassified as cropland lakes due to clearing.	4,100 acres 4,070-acre gain due to land clearing.
Plan 4 EQ	2,200 acres in 2030 16,000-acre loss from base due to sedimentation and falling water levels. 300-acre gain over FWO.	38,300 acres in 2030 3,700-acre loss from base due to sedimentation and falling water levels. 4,300-acre gain over FWO due mostly to environmental easements.	30 acres in 2030 Retains present conditions.
Plan 7 NED	1,800 acres in 2030 16,400-acre loss from base due to sedimentation and falling water levels. 100-acre loss from FWO.	33,400 acres in 2030 8,600-acre loss from base due to sedimentation and falling water levels and about 4,600 acres reclassified as cropland lakes due to clearing.	4,900 acres in 2030 4,870-acre gain over base due to land clearing. 800-acre gain over FWO due to land clearing.
Plan 9 R	2,200 acres in 2030 Impacts similar to Plan 4.	38,300 acres in 2030 Impacts similar to Plan 4.	30 acres in 2030 Impacts similar to Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	BRACKISH AND SALINE MARSH BAYOUS, CANALS, AND BORROW PITS	MARSH PONDS AND LAKES
Base	Brackish bayous 6,200 acres. Saline bayous 6,100 acres.	Fresh 87,600 acres. Brackish 55,200 acres. Saline 64,400 acres.
FWO	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Increase due to erosion of brackish and saline marsh.	Fresh 141,600 acres in 2030. Brackish 75,300 acres in 2030. Saline 99,000 acres in 2030. 54,000-acre gain of fresh, 20,100-acre gain of brackish, 34,600-acre gain of saline due to "natural" deterioration of marsh.
Plan 4 EQ	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Same as FWO.	Same as FWO.
Plan 7 NED	Brackish 8,300 acres by 2030. Saline 7,400 acres by 2030. Saline same as FWO, additional brackish marsh deterioration caused by Avoca Island levee extension would lead to increase of 200 acres of brackish bayous.	Fresh 142,400 acres in 2030. Brackish 76,300 acres in 2030. Saline 99,100 acres in 2030. Gains slightly larger than FWO. Construction of Avoca Island levee would increase formation of ponds.
Plan 9 R	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Same as FWO.	Same as FWO.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	BAYS AND OPEN GULF	FLOOD-CARRYING CAPACITY	NATURAL AND SCENIC STREAMS
Base	Fresh bays 200,000 acres. Brackish bays 58,900 acres. Saline bays 53,800 acres. Shallow gulf 804,000 acres.	The floodway system is inadequate at present. It can pass only 850,000 cfs of its assigned capacity of 1.5 million cfs.	Bayou Penchant
FWO	Fresh bays 75,100 acres in 2030. Others same as base. Loss of 124,900 acres of fresh bays due to growth of delta in Atchafalaya Bay.	Carrying capacity would increase to 1.5 million cfs by raising the levees. This would be a long and expensive process.	Scenic quality could decrease or change as water levels rise due to rising Atchafalaya River flowline.
Plan 4 EQ	75,100 acres of fresh bays in 2030. Others same as base. Loss of 124,900 acres of fresh bays due to growth of delta in Atchafalaya Bay.	This plan would pass 1.5 million cfs to the gulf, but due to its higher flowline and increased costs, it would take the longest of any plan to achieve the desired capacity.	Same as FWO.
Plan 7 NED	75,400 acres of fresh bays in 2030. Others same as base. Loss of 120,600 acres of fresh bays due to growth of delta in Atchafalaya Bay.	This plan would safely carry the 1.5 million cfs to the gulf.	Avoca Island levee would prevent rising water levels and possibly help preserve existing scenic quality.
Plan 9 R	75,100 acres fresh bays in 2030. Others same as base. Impacts similar to Plan 4.	Impacts similar to Plan 7.	Same as FWO.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	WATER QUALITY	NAVIGABLE WATERWAYS
Base	River water is high in suspended sediments, DO and nutrients. Overbank areas experience low DO levels during much of the year. Nutrients are sufficiently available within the Lower Floodway for complete bacterial metabolism of organic matter. Areas outside of Floodway have higher DO and more phytoplankton.	Many navigable waterways present, with good access to most areas.
FWO	Water quality in overbank areas would deteriorate as average levels and circulation decrease. Further sedimentation would cause even lower DO. Increases in agriculture and industry would lead to potential problems of pesticide and heavy metal concentrations.	Present conditions would be maintained.
Plan 4 EQ	MU's would maintain desirable water levels and flow patterns. Sedimentation would be reduced by distributary realinement. Environmental easements would prevent water quality problems associated with agricultural and industrial development.	Adverse impacts would occur due to MU's, channel training in the Atchafalaya River, and restriction of WLO.
Plan 7 NED	Channel training and outlet flow concentration through LAR would lower flowline. Absence of MU's, together with other features, would reduce overbank water supplies. Avoca Island levee extension would limit freshwater input to Terrebonne marshes, but diversion structure(s) could compensate for this effect.	Adverse impacts would occur due to channel training in Atchafalaya River and LAR, extension of Avoca Island levee and closure of WLO.
Plan 9 R	Impacts similar to Plan 4. Possible flow distribution between WLO and LAR, along with channel training, would result in lessened overbank flow into adjacent marshes.	Adverse impacts would occur due to MU's, channel training of the Atchafalaya River and LAR, and restriction of WLO.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	FISHERIES
Base	The overflow system of the LABF supports a fishery rich in numbers and species. Crawfish harvest averages 15 million pounds yearly. Marshes support an important estuarine fishery. Annual average harvest of shrimp, 47.8 million pounds; menhaden, 173 million pounds.
FWO	Fisheries productivity would decline from present due to loss of aquatic habitat because of sedimentation, lowering of water levels and marsh deterioration. Agriculture would increase sediments and pesticides in the aquatic system. Crawfish MSY would drop 39 percent from present.
Plan 4 EQ	Overall fishery productivity would be less than present, but more than under FWO project or Plan 7 conditions. MU's would increase fishery productivity by flooding more land deeper and longer than under FWO condition, and by preserving permanent aquatic habitat at low water. Crawfish MSY would drop 28 percent from present. Estuarine fishery resources would decrease slightly from the present and future without-project conditions. Widening Wax Lake Outlet overbank would benefit fisheries by reconnecting 7,800 acres of cypress-tupelo to the river and tidal system. 12,090 acres of borrow pits would be created which would enhance fisheries.
Plan 7 NED	Overall fishery productivity would be lowest with this plan. Sedimentation would destroy thousands of acres of aquatic habitat in the LABF and severe water quality problems would occur. Additional agriculture would increase pesticides and sediments, which would reduce fisheries. Crawfish MSY would drop 48 percent from present. Avoca Island levee alinement would cause greatest loss of estuarine fisheries of any plan. Widening of Wax Lake Outlet and construction of 13,220 acres of borrow pits would have benefits described in Plan 4.
Plan 9 R	Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	WILDLIFE	ROOKERIES
Base	A great variety of wildlife exists throughout the project area.	Numerous rookeries occur in the project-affected area.
FWO	A highly significant decrease in wildlife would occur due to destruction and degradation of forests, marshes, and aquatic habitats due to clearing for agriculture, sedimentation, and levee raising.	A number would disappear due to decline in feeding habitat for birds that use them.
Plan 4 EQ	A slight decrease in wildlife would occur due to marsh deterioration, and direct construction impacts. However, there would be a gain in wildlife over future without-project conditions.	500 acres of rookeries would be protected by special easements. Environmental easements and management units would preserve feeding habitat for birds. Recreation features would increase public use, causing increased harrassment of birds during nesting.
Plan 7 NED	A highly significant decrease in wildlife would occur due to loss of forestland in the LABF and backwater area, marsh deterioration, and direct construction impacts.	No protection by easements. Least feeding habitat of any plan would be preserved. Recreational impacts same as those of Plan 4. Clearing would cause increased pesticide pollution in aquatic areas which would adversely impact birds. Channel training of the LAR could disrupt several sites.
Plan 9 R	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4 but channel training of the LAR could disrupt several sites.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	AUDUBON SOCIETY BLUE LIST SPECIES	ENDANGERED AND THREATENED SPECIES	RECREATION
Base	Range of 50 species includes project area.	16 endangered or threatened species occur or might be expected to occur in project area.	269,000 annual user-days of supply valued at $7,469,000.
FWO	Species living in forests or marshes would decline in numbers as their habitat declines.	Six species would be affected adversely.	250,800 average annual equivalent user-days of supply valued at $6,892,000.
Plan 4 EQ	Plan would benefit forest species.	Two species would be benefited and two species adversely affected.	$1,537,000 average annual equivalent user-days of supply valued at $25,230,000. Real estate features preserve forest and provide access which enhances recreation. Fee acquisition of 1,500 acres provides a large amount of this recreation.
Plan 7 NED	Plan would be greatly detrimental to most species--especially those inhabiting forests and marshes. Increased pollution caused by agriculture would also have adverse impacts.	Same as FWO	1,273,000 average annual equivalent user-days of supply valued at $23,354,000. Clearing for agriculture and construction impacts, and loss of delta caused by Avoca Island levee would reduce recreation when compared to Plans 4 or 9. Major source of recreation in this plan is fee acquisition of 1,500 acres.
Plan 9 R	Impacts similar to those of Plan 4.	Same as Plan 4.	1,320,900 average annual equivalent user-days of supply valued at $24,944,000. Conditions very similar to Plan 4. Recreational development features are idential to that of Plan 7.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	WILDLIFE REFUGES AND MANAGEMENT AREAS	TIMBER	OIL, GAS, AND MINERALS
Base	One national refuge and 11 state management areas in project area. Two in project-affected area.	Commercial forests comprise 40 percent study area. $5,960,000 average annual net income.	Extensive oil, gas, and mineral activities in project-affected area.
FWO	The two management areas in the project-affected area would increase in size and terrestrial habitat quality due to sedimentation and plant succession. Aquatic habitat quality would decrease due to pollution.	Resource would decrease significantly as land clearing continues and harvest of existing cypress forest progresses. $4,362,000 annual net income by 2030.	No impacts, but oil and gas extraction would become much less important as reserves are depleted.
Plan 4 EQ	Public use would be increased in the two areas in project-affected area.	Resource would decrease slightly from present due to construction impacts. However, resource would be significantly greater than under FWO. $5,458,000 annual net income by 2030.	Channel training above Morgan City and closure to Wax Lake Outlet could have adverse impacts on access for exploration and production of oil and gas. Management units could also cause minor inconveniences.
Plan 7 NED	Public use would be increased as in Plan 4. Channel alinement of Avoca Island levee could destroy 4,000 acres of newly developed delta in Atchafalaya Delta Management Area by 2030 and an additional 17,000 acres by 2080.	By 2030, about one-fourth of the timber resources in the area would be lost due to clearing in the floodway and the backwater area. $4,148,000 annual net income by 2030.	Impacts similar to those of Plan 4 with additional impacts due to the Avoca Island levee extension and channel training below Morgan City, which could limit access for exploration and production of oil and gas.
Plan 9 R	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4. $5,477,000 annual net income by 2030.	Impacts similar to those of Plan 4, except channel training below Morgan City could limit access.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	CULTURE OF THE BASIN	NATIONAL TRUST PROPERTIES
Base	A unique folk culture, based upon utilization of swamp resources, developed in the basin in the mid-1800's. Although the heart of the swamps has largely been abandoned and the inhabitants have moved to the edges of floodway, folk traditions, lifestyles and skills remain.	There are no National Trust properties in the project-affected area.
FWO	The continuing sedimentation and drainage of the swamps would adversely impact the extractive economy base, and thus, the life-style of those who live on the edges of the floodway. This would have far-reaching effects upon folk culture.	
Plan 4 EQ	This plan would slow the deterioration of the natural conditions upon which the folk culture of the basin is based. However, increased recreational use of the basin would conflict with established commercial use patterns.	
Plan 7 NED	This plan would be the most detrimental as it would accelerate deterioration of swamp production and thus, undercut the economic base of the basin's folk culture. Increased recreational use would cause competition between recreationists and commercial fishermen over the dwindling resource base.	
Plan 9 R	Impacts similar to those of Plan 4.	

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	NATIONAL REGISTER PROPERTIES	ARCHEOLOGICAL RESOURCES
Base	Two archeological sites have been determined eligible for the National Register of Historic Places. Ten additional significant cultural resources possibly eligible for inclusion in the National Register also exist.	Over 252 prehistoric and historic archeological sites are recorded. However, these sites represent an incomplete sample of the resources expected to exist.
FWO	The ongoing levee enlargement would possibly impact one of the National Register-eligible properties, and six of the 10 cultural re-resources identified possibly eligible for the National Register.	Archeological resources would be adversely affected as the burial of sites by sedimentation, unregulated development in the basin, the widening and deepening of the Atchafalaya River, and ongoing levee enlargement would continue.
Plan 4 EQ	Same as FWO except that other project features would possibly impact additional cultural resources identified by future investigations as eligible for the National Register.	By regulating land development and maintaining natural conditions through management units, this plan would lessen the processes that adversely impact archeological resources. However, construction related to project features would affect archeological sites and increased public access would increase vandalism and pothunting.
Plan 7 NED	Impacts similar to those of Plan 4.	This plan would be the most detrimental to the resource base as it would accelerate the processes that adversely impact archeological resources. Construction related to project features and increased public access would adversely affect archeological resources.
Plan 9 R	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	NATIONAL REGISTRY OF NATURAL LANDMARKS	OPEN SPACE	AIR QUALITY
Base	Basin being evaluated as natural landmark.	Largest contiguous, roadless semiwilderness in Louisiana.	Quality is generally good, except near industrial facilities.
FWO	Only moderate amount of land in LABF would be preserved in natural state, thus little land would be available for inclusion in landmark.	Amount and quality of open space in LABF would decrease while need for such spaces grew. Rising water levels would preserve open space in backwater area. Continued oil development would decrease quality.	Quality would decrease as development and agriculture expansion spread.
Plan 4 EQ	Would preserve large amounts of habitat in natural state and allow greatest flexibility in choosing landmark lands.	Open space preserved in LABF and backwater area.	Existing quality would be preserved.
Plan 7 NED	Would preserve least land in natural state of any plan. Thus amount of land available for consideration would be less.	Greatest amount of open space, both in LABF and backwater area, would be lost.	Quality would deteriorate throughout the area even more than under FWO conditions.
Plan 9 R	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	ESTHETIC VALUES	UNDEVELOPED LAND	PROPERTY OWNERSHIP
Base	Value high due to semiwilderness nature of area despite oil and gas activities.	Several hundred thousand acres of marsh and forest.	In LABF approximately 60 percent of privately-owned land is vested in 13 major property owners. The remaining 175,000 acres are controlled by some 3,200 owners.
FWO	Quality would continue to deteriorate as sedimentation continues to fill in open water areas and as oil and gas activity expands and logging accelerates.	Much of the existing undeveloped forest land would be developed for agriculture, industry, or residential development. Forests in backwater would not be cleared due to rising water levels.	Impacts would occur to the extent of land requirements for levee raising.
Plan 4 EQ	Values would decline from present as sedimentation, and oil, and gas activities continue and logging accelerates. Decline would be far less than under FWO. Real estate features would preserve forests in LABF. Overall, plan would benefit esthetic values.	Environmental easements would prevent clearing in LABF.	In addition to land requirements for plan construction, there would be impacts due to nondevelopment easements, flowage easements, environmental easements, and fee acquisitions in the lower floodway.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	ESTHETIC VALUES	UNDEVELOPED LAND	PROPERTY OWNERSHIP
Plan 7 NED	Even greater degradation of esthetic values in LABF and Atchafalaya Bay would occur than under FWO. Construction of Avoca Island levee through center of developing delta would degrade esthetics.	Greatest development would occur with this plan, both in the LABF and in the backwater area with consequent loss of undeveloped land.	Impacts due to and requirements for construction would be greater than those of Plan 4, but much less for real estate features, since this plan includes only fee acquisitions and nondevelopment and flowage easements.
Plan 9 R	Impacts similar to those of Plan 4, but channel training along the Lower Atchafalaya River Lake Outlet would degrade esthetics.	Impact similar to those of Plan 4.	Impacts similar to those of Plan 4, except fee purchases from willing sellers for public access would replace public access and timber ownership easements.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	NOISE	DISPLACEMENT OF PEOPLE	COMMUNITY COHESION
Base	Area is relatively noise free compared to other areas. Most existing noise due to boat traffic.	-	Unique cultural heritage and lifestyles of the Atchafalaya Basin dependent on swamp resource utilization have created strong community cohesion.
FWO	Noise levels would increase as agricultural and oil and gas development multiplied. Noise associated with recreation and and commercial fishing would decrease.	Displacements would occur as a result of levee raising. Rising water levels in backwater area could cause displacement of residents.	The LABF would become drier and with the conversion of forest to cropland it would become increasingly more difficult to preserve traditional lifestyles and communities.
Plan 4 EQ	In southern portion of the area, plan would preserve aquatic habitat and boating would increase noise levels over FWO. In northern portion, environmental easement would keep area quieter than under FWO.	Similar to FWO, but widening Wax Lake overbank would cause additional displacements.	Preservation of swamp habitat would help to maintain traditional lifestyles. However, there might be adverse impacts resulting from increased public access and from rising water levels in the backwater area.
Plan 7 NED	Permanent noise would be greatest with this plan due to agricultural development and recreational usage.	Impacts similar to those of Plan 4, but with no displacement of residents in backwater area.	Impacts essentially the same as FWO except for a beneficial impact due to the Avoca Island levee preventing rising water levels and an adverse impact resulting from increased public access.
Plan 9 R	Noise levels would be similar to those of Plan 4.	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	COMMUNITY GROWTH	LOCAL GOVERNMENT FINANCE, TAX REVENUES, AND PROPERTY VALUES	PUBLIC FACILITIES AND SERVICES
Base	-	-	-
FWO	The most significant influence on community growth would be the negative effects resulting from rising backwater area water levels.	The conversion of forestland to cropland could cause the converted acres to be assessed and taxed at a higher rate, increasing the tax base and contributing favorably to tax income. However, rising backwater area stages would tend to reduce the tax base.	No impacts.
Plan 4 EQ	This plan would restrict growth through easements and due to rising backwater area stages.	Threat to tax base in backwater area would be less than with FWO. Also some small increases in sales tax revenue by increased expenditures of recreationists.	Increased visitations in the lower floodway resulting from the recreation development plan might necessitate a greater level of public services, e.g., sanitation and law enforcement.
Plan 7 NED	This plan would remove the hindrance to growth in the backwater area, and would not restrict agricultural development in the floodway.	Same as FWO but to a larger degree, with respect to forestland conversion. Effects on sales tax revenue would be the the same as EQ.	Impacts similar to those of Plan 4.
Plan 9 R	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	BUSINESS AND INDUSTRIAL ACTIVITY AND REGIONAL GROWTH	EMPLOYMENT	DISPLACEMENT OF FARMS
Base	The industrial complex located in and around Morgan City holds the greatest potential for spurring regional growth.		
FWO	Rising stages in the backwater area would pose a significant hindrance to the growth potential of the Morgan City industrial complex.	Minor employment opportunities would be provided by levee raising and conversion of forest to cropland. Destruction of fisheries habitat would reduce employment opportunities. Rising stages in the backwater area would reduce employment opportunities in business and industry.	Approximately 7,000 acres of agricultural land in the backwater area could be lost due to rising water levels.
Plan 4 EQ	Similar to FWO, but to a lesser degree.	Minor employment opportunities would be provided by construction of plan features. Employment decline in fishing would be greatly reduced as fisheries habitat is preserved. Rising stages in backwater area would have less effect than under FWO.	Same as FWO.
Plan 7 NED	By extending the Avoca Island levee, the impediment to industrial expansion and regional growth would be lessened.	Essentially the same as FWO except employment opportunities in business and industry would not be lost due to rising stages in the backwater area.	No displacement of agricultural land would occur.
Plan 9 R	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.	Impacts similar to those of Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	VECTORS
Base	Numerous mosquito vectors occur throughout the project area.
FWO	Same as base.
Plan 4 EQ	Certain project features would temporarily increase vector population.
Plan 7 NED	Same as Plan 4.
Plan 9 R	Same as Plan 4.

TABLE 4-7 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

	TOTAL FIRST COST[1/]	NET BENEFITS (nonflood control)[2/]	BENEFIT/COST RATIO (nonflood control)[2/]
Base	-	-	-
FWO	$669,000,000[3/]	No contribution.	
Plan 4 EQ	$1,032,652,000	$445,000 average annual	1.02 to 1
Plan 7 NED	$939,433,000	$14,496,000 average annual	8.1 to 1
Plan 9 R	$1,004,790,000	$151,000 average annual	1.01 to 1

1/ Includes construction and mitigation costs for the first reach of the Avoca Island levee extension (in plan 7). With full extension, total first costs would be $1,239,901,000.

2/ The estimates presented here are for the nonflood control values applicable to each plan. The flood control aspects are considered a part of the overall MR&T project and as such are not subject to incremental evaluation.

3/ These costs include levee raising only, and do not provide for protection of the area northeast of Morgan City from backwater flooding, nor do they provide for preservation of the basin's fish and wildlife resources, nor do they provide for any recreational development.

5. AFFECTED ENVIRONMENT

Environmental Conditions

5.1 The project area, consisting of the Red River backwater area, the Atchafalaya Basin Floodway system, the backwater area northeast of Morgan City and coastal marshes, is a vast lowland region confined by major meander belts of the Lower Mississippi and Red Rivers. The Atchafalaya River formed along the axis of this area about 500 years ago and today exists as the major distributary of the Mississippi River. The Atchafalaya Basin system conveys about 30 percent of the combined flows of the Red and Mississippi Rivers southward to the Gulf of Mexico through a system consisting of the Old River control structure, the river proper, and many interconnected channels, swamps, lakes, and marshes. The Atchafalaya River is bounded on the east and west by artificial levees, built in the 1930's and located at an average distance of about 7 miles from the main river channel. Within this area, impacts due to the proposed implementation of the plans evaluated in this EIS would occur primarily in the area south of US Highway 190. Within this project-affected area (Figure 5-1), the predominant habitat types are bottomland hardwood forest, cypress-tupelo swamps, marshland, and cultivated farmland. Much of the project-affected area is subject to occasional overbank flooding from the Atchafalaya River. In the leveed floodway portion south of Interstate Highway 10 (I-10) overbank flooding is usually an annual event. This annual overbank flooding is the driving force behind a system in which decaying vegetation (called detritus) is formed within the swamps and forests, as waters rise in the spring. This detritus and its attendant bacteria become food for invertebrate animals, and nutrients released by decay of detritus nourish microscopic floating plants which, in turn, serve as food for microscopic animals. The rising river waters carry some types of microscopic plants and animals into flooded forests and pick up others from lakes and introduce them throughout the system. Bottom-dwelling animals are similarly dispersed. The project-affected area serves as highly valuable habitat for a variety of fish and wildlife species, as well as being one of the largest and most important semi-natural areas remaining in the United States. This area is heavily used for commercial fishing and for fish- and wildlife-oriented recreational purposes. The human population of the project-affected area is primarily rural and highly dependent upon the natural resources of soil, minerals, timber, fish, and wildlife for livelihood. A large part of this population is descended from French-speaking Acadian exiles who began coming to Louisiana in the 1770's. North of I-10 and along the Mississippi and Lafourche Ridges, farming activities are highly important. Considerable acreage here is devoted to the growth of soybeans. South of I-10, agriculture is less important and the economy is based on commercial fishing and trapping, outdoor recreation, and the extraction of oil and gas.

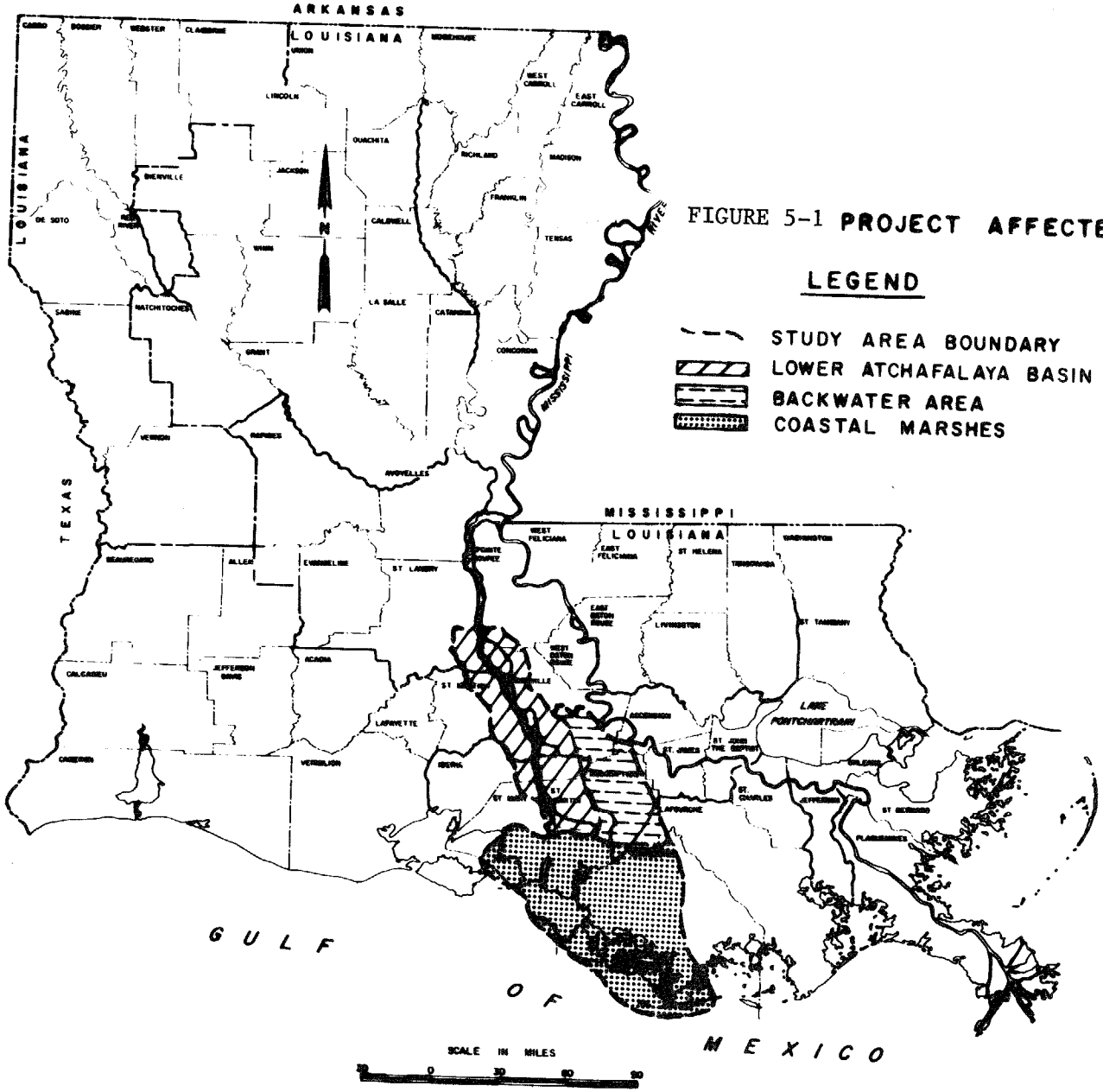


FIGURE 5-1 **PROJECT AFFECTED AREA**

5.2 Under future without-project conditions, the project-affected area would undergo profound changes. Due to the maturation of the Atchafalaya River main channel, average water levels within the floodway would decrease, leading to an expansion of land clearing and agricultural activity. Future sedimentation within the floodway would also contribute to this agricultural expansion due to a raising of land elevation. These changes would lead to a highly significant decrease in the productivity of the area for fish and wildlife and to a decline in recreational potential. In the backwater area northeast of Morgan City, rising water levels would occur due to the growth of the Atchafalaya River delta. These rising water levels could have detrimental effects upon the forests of this area as well as to existing agricultural lands, residential or industrial developments, and cultural resources. Additional details of all these changes can be found in the remaining parts of Section 5, and in Section 6, which deals with the environmental effects of the various plans.

Significant Resources

EARLY SUCCESSIONAL STAGE BOTTOMLAND HARDWOOD FORESTS

5.3 Approximately 94,000 acres of this pioneer forest occur within the project-affected area, primarily south of I-10 (Plates 2 through 4). This forest type is most widespread on the newly accreted lands that have been formed in and around Grand and Sixmile Lakes. Species composition of these forests varies with the age of the accreted lands, with pure stands of willow predominant on younger areas and mixed stands of cottonwood, willow, and sycamore occurring on older areas (a list of scientific names of plant species mentioned in this report can be found in Appendix G). Other species, such as ash, maple, and cypress, may be found growing in association with the three dominant species. Common understory and groundstory species found in these forests are waxmyrtle, false nettle, lizard's tail, blackberry, shield fern, and smartweed. These forests are valuable as wildlife habitat for species such as deer, swamp rabbits, and songbirds and will eventually develop into highly productive, late successional stage bottomland hardwood forests. Approximately 73,000 acres of early successional forest are flooded for a few days to a few months during an average spring. These flooded acres provide habitat for fish and crawfish and the detritus they produce furnishes food to various aquatic animals. Under future without-project conditions, the acreage of early successional forest would decrease by about two-thirds due to plant succession and land clearing. Approximately 2,700 acres of this decrease would be due to raising the protection levees surrounding the lower floodway.

LATE SUCCESSIONAL STAGE BOTTOMLAND HARDWOOD FORESTS

5.4 Approximately 332,000 acres of late successional stage, mixed bottomland hardwood forests are found within the project-affected area, primarily north of I-10 and in the backwater area northeast of Morgan City (Plates 2 through 4). Tree species composition of these forests varies according to the wetness of the site. Water oak, willow oak, sweetgum, and American elm are common species in the drier areas and Nuttall oak, overcup oak, bitter pecan, ash, and Drummond red maple are common on wetter sites. Live oak is a common species on dry sites in the southern one-third of the area. Common understory and ground story species present are swamp privet, water elm, poison ivy, greenbrier, rattan vine, shield fern, false nettle, and butterweed.

5.5 These forests are highly productive in terms of wildlife and commercial forest products and also act as aquatic habitat when waters rise in the spring. About 128,000 acres are flooded during an average year. White-tailed deer, gray and fox squirrels, swamp rabbits, and woodcock are common game species found throughout this forest type. These forests also serve as habitat for an abundance of songbirds, reptiles, amphibians, and small animals. Commercial forest products derived from these areas include lumber, pulpwood, and veneer.

5.6 Forests of this type are rapidly disappearing from the lower Mississippi Valley due to agricultural expansion, and the forests of the project-affected area represent one of the largest expanses remaining intact anywhere in the nation. Under future without-project conditions, the acreage of this habitat type would decrease by about 50 percent due to clearing of land for agriculture and to a loss of about 9,200 acres due to raising the protection levees around the lower floodway.

CYPRESS-TUPELO SWAMPS

5.7 Approximately 451,000 acres of cypress-tupelo swamps may be found within the project-affected area (Plates 2 through 4). Dominant trees in these swamps include cypress, tupelo, swamp red maple, and pumpkin ash. Common understory plants include snowbell, buttonbush, Virginia willow, swamp privet, and water elm. Typical ground cover includes water hyacinth, lizard's tail, pickerelweed, and smartweed. Water from a few inches to several feet in depth covers the swamp floor much of the year; but during low water river stages, the areas may become dry. These swamps are less productive in terms of wildlife than are bottomland hardwood forests, but serve as high quality aquatic areas when flooded due to the large amount of habitat they provide and the input of detritus they add to the system. The most productive crawfish habitat of the study area occurs in these swamps,

which are also of high value to wading birds and other waterfowl, as well as to furbearing mammals such as the mink and otter. These swamps also serve as important habitat for the American alligator. Many of the esthetic qualities that make the study area valuable for recreational usage can be found in these swamps. Under future without-project conditions, the total acreage of this habitat type would decrease only slightly, although logging activity coupled with changes in hydrological conditions could cause drastic changes in the nature of these forests. By 2030, it is estimated that half of the cypress-tupelo areas would have been logged, and approximately 2,400 acres of swamp would have been destroyed due to raising the protection levees around the lower floodway.

AGRICULTURAL LANDS

5.8 High-quality agricultural lands occur throughout the project-affected area whenever soil moisture conditions during the growing season are low enough to permit growth of cultivated crops. These farmlands generally are on the higher elevations, with major farming activity concentrated along the Teche Ridge in the south, and the Lafourche Ridge to the east. The primary crops produced on these lands are soybeans in the north and sugarcane in the south. Some land is also used for rice, corn, cotton, and hay crops; and small amounts of pastureland occur. Much of this land is eligible for classification as prime and unique farmland (Plates 20 through 22). The Atchafalaya Basin Floodway contains little land of high value for agriculture due to the excessive flooding that occurs over much of the area.

5.9 The agricultural lands of the project area are of major significance to both the economy and as a source of high quality protein that may be eaten by both humans and domestic animals. Under future without-project conditions, agricultural lands would nearly triple in acreage by 2030.

FRESH MARSH

5.10 At the present time, there are approximately 321,000 acres of fresh marsh in the project area (Plates 2 through 4). The marshes near the Lower Atchafalaya River and Wax Lake Outlet are generally decreasing in acreage at a slow rate while those removed from river overflow are rapidly decreasing in acreage. Under future without-project conditions, there would be an estimated 243,000 acres of fresh marsh in the area in 2030. This reduction would be expected to continue from 2030 to 2080. These marshes contain a variety of plants, the most common being maidencane and bulltongue. Salinities range

from 0.06 parts per thousand (ppt) to 6.7 ppt and average 1.5 ppt. Fresh marshes provide prime habitat for nutria and also attract large numbers of wading birds, red-winged blackbirds, and wintering ducks and geese. Several kinds of reptiles and amphibians are present, including the American alligator. As they flood, these marshes act as habitat for numerous fish. These marshes provide numerous user-days of hunting and sport fishing. Detritus from marshes is a vital part of the food base of the aquatic system. However, because tidal fluctuation is low, much of the dead material builds up as peat deposits. The fresh marshes near Morgan City provide feeding habitat for the largest concentration of Southern bald eagles in the south-central United States. Overall, the project area marshes are the largest contiguous tract of fresh marsh in the state and are, therefore, a national resource of great tangible and intangible value.

BRACKISH MARSH

5.11 There are approximately 89,000 acres of brackish marsh in the project-affected area (Plates 2 through 4). Under future without-project conditions, there would be a decrease of about 25,000 acres by 2030. This trend would be expected to continue through 2080. Plant diversity in brackish marsh is less than in fresh marsh, with wiregrass being the dominant plant. Salinities generally range from 6 to 18 ppt with a mean of 8 ppt. Brackish marshes, excellent muskrat habitat, also attract wintering waterfowl in moderate numbers. Wading birds, sea birds, and shore birds are also common. Numbers and kinds of reptiles and amphibians are less than in fresh marsh. Brackish marshes provide valuable nursery habitat for several species of fish and shellfish, especially for white shrimp and menhaden; and the detritus they furnish is vital to the aquatic system. Brackish marshes sustain less hunting and trapping than fresh marshes.

SALINE MARSH

5.12 Approximately 107,000 acres of saline marsh border the gulf in the Terrebonne Parish portion of the project-affected area (Plates 2 through 4). Under future without-project conditions, this area would be reduced to 69,000 acres by 2030 as saline marshes deteriorated into ponds or were converted into brackish marsh. This reduction would be expected to continue through 2080. Salinities within these marshes can range from 1 to 52 ppt with a mean of 16 ppt. Oystergrass is the dominant plant present. There are few mammals, reptiles, or amphibians present. Gulls, terns, and other shore birds are common because of the extensive mudflats uncovered by tidal fluctuations. The saline marshes provide vital nursery habitat for young fish and shellfish such as seatrout, shrimp, and blue

crabs. The detritus produced by this marsh is flushed into the bays and gulf by the tides, and this detritus nourishes the entire system. Hunting and trapping are not important pursuits in this marsh type; yet, sport fishing is common. These marshes form the initial barrier protecting inland areas from destructive effects of storms such as hurricanes.

ATCHAFALAYA DELTA

5.13 Before 1950, the mainstem lakes within the Atchafalaya Basin were receiving most of the sediments of the Atchafalaya River and a lake delta was filling them. By 1960, the lakes were mostly filled and silt was being carried into Atchafalaya Bay where it was building shoals at the mouths of the Lower Atchafalaya River and Wax Lake Outlet. With the flood of 1973, enough sediment was deposited to cause the land to finally become visible. Major floods followed in 1974 and 1975, and at the present time, there are approximately 10,100 acres of new land in the bay (Plate 1). Since it is impossible to predict the amount of marsh, natural levee, dredged material disposal areas, ponds and bayous that would appear in this newly emergent land, the whole mass has been simply classified as delta.

5.14 A major navigation channel passes through the delta. This channel may be retarding westerly growth of the delta and shunting sediment into the slightly deeper waters offshore instead of into the bay. This delta is of major significance because Louisiana may be losing approximately 39 square miles of marsh per year (Wicker et al., 1980). Predictions show that without the project, there would be 135,000 acres of delta by 2030, an average growth rate of 4.2 square miles per year. The delta marsh is extremely productive in terms of biological resources. It contributes to hunting, trapping, sport and commercial fishing, and other wildlife-oriented activities. The entire area is a wildlife management area. The area is significant from a purely scholarly standpoint because it is one of the few developing deltas in the United States. Scientific investigations are today being conducted to expand understanding of the geological and ecological processes that occur in such areas.

RIVER, MAJOR DISTRIBUTARY, AND MAIN STREAM LAKES

5.15 At the present time, there are 23,000 acres of this habitat in the Lower Atchafalaya Basin Floodway and 8,100 acres in the backwater area. These water bodies are turbid and have moderate to fast currents, lower temperatures, and higher dissolved oxygen than other waters. Riverine waters are the main source of nitrogen and phosphorus to fuel the primary production in the lower floodway (Bryan

et al., 1974, 1975, 1976). These swift, turbid waters contain few plants or bottom-dwelling animals. However, these waters serve to transport microscopic plants and animals into all parts of the basin during flooding. Depths in the river and major distributaries usually range from 10 to 20 feet. Main stream lakes are shallow except where the river channel passes through them. During the next 50 years, under future without-project conditions, surface acreage of riverine habitat within the lower floodway would be expected to increase slightly because of erosion. In the period between 2030 and 2080, this trend would probably continue.

FRESH BAYOUS, CANALS, AND BORROW PITS

5.16 This habitat type covers 38,000 acres of the project-affected area at the present time, including 15,900 acres in the Lower Atchafalaya Basin Floodway. Approximately 4,340 acres are borrow pits built between 1972 and 1980 during levee construction for this project. These waterways are slow-moving except during flood season and depths are usually less than 6 feet. Dissolved oxygen levels in basin bayous are consistently slightly lower than in other habitat types. Rooted aquatic plants are common in these waters. Bayous, generally having numerous bottom-dwelling animals, serve as avenues for fish to move between riverine waters and the lakes and swamps. During the summer when waters recede from swamps and forests, fish congregate in bayous. They often seek refuge here during hot weather when temperatures get very high in shallow lakes. Under future without-project conditions, there would be 50,900 acres of bayous and canals by 2030. This increase of 12,900 acres would be due primarily to the construction of borrow pits to raise various levees. As sedimentation continues and the flowline drops, most bayous would become more shallow, and some that contain permanent water now would have water only during high river stages. During the 2030 to 2080 period, it is probable that the acreage of bayous in the basin would decrease due to sedimentation and falling water levels while the acreage of bayous in the marshes would increase due to erosion.

HEADWATER LAKES

5.17 The 17,000 acres of headwater lakes in the project-affected area lie mostly in the Lower Atchafalaya Basin Floodway. These lakes receive a complete flushing by flowing water during the year. They are very valuable aquatic habitat because of the addition of nutrients during overbank flooding, their relatively high levels of dissolved oxygen, and their favorable temperatures. Most such lakes are fairly clear in the summer and have a heavy growth of rooted aquatic plants and a thriving population of plankton. Many kinds of bottom-dwelling

animals inhabit these lakes. The red swamp crawfish is abundant in the spring and fish are common through the year. Shallow water bodies such as these also contain a great diversity of reptiles and amphibians. Under future without-project conditions, there would only be an estimated 1,900 acres of such lakes remaining in the area in 2030 because of the heavy sediment loadings and falling water levels. Other lakes would remain, but would be reclassified as cropland lakes due to the agricultural fields surrounding them. Water quality of headwater lakes would be reduced because of turbidity and pesticides due to farming. By 2080, it is probable that all such lakes in the lower floodway would be eliminated. It is possible that, as the swamp develops below Morgan City, some of the existing lakes would be reclassified as headwater lakes.

BACKWATER LAKES

5.18 These lakes rarely receive a thorough flushing from the river. Most of the time the water enters them from downstream. There are 42,000 acres of such lakes in the project-affected area; 13,300 of these are in the Lower Atchafalaya Basin Floodway, and the remainder in the backwater area. Less is known about this type lake than the other types; but, in general, they are less productive than headwater lakes because dissolved oxygen and nutrients are usually present in lower amounts. Under future without-project conditions there would be an estimated 34,000 acres of backwater lakes in the project-affected area by 2030. The entire loss of 8,000 acres would be in the lower floodway and would be due to sedimentation, the lowered flowline, and agricultural expansion, which would result in some lakes being reclassified as cropland lakes. Water quality would deteriorate in the remaining backwater lakes. By 2080, it is probable that very little habitat of this type would remain.

CROPLAND LAKES

5.19 A cropland lake is one that is entirely surrounded by agricultural lands. At the present time, there are only 27 acres of this habitat in the project-affected area. These lakes are moderately deep and excessively rich in nutrients due to fertilizer runoff from fields. They are usually high in pesticides, which are detrimental to fish life. By 2030, it is estimated that there would be 4,100 acres of such lakes in the area. By 2080, the acreage would increase even more as clearing for agriculture continued below I-10.

BRACKISH AND SALINE MARSH BAYOUS, CANALS, AND BORROW PITS

5.20 At the present time, there are approximately 6,200 acres of brackish bayous and canals, and 6,100 acres of saline bayous and canals in the marsh area. These bayous and canals have fairly low suspended solid concentrations and dissolved oxygen conditions are usually adequate for aquatic life. Salinities vary with the marsh type with which they are associated. Temperature ranges are usually less than in adjacent ponds and these bayous serve as a refuge during times of extreme temperature. They also serve as a passageway between ponds and bays. By 2030, under future without-project conditions, the acreage of brackish bayous would increase by 1,900 acres and that of saline bayous by 1,300 acres. This change would occur as brackish and saline marsh deteriorated. The same trend would probably continue from 2030 to 2080.

MARSH PONDS AND LAKES

5.21 Acreage of this habitat type in 1980 was as follows: fresh, 87,600; brackish, 55,200; and saline, 64,400. Fresh ponds and lakes provide valuable habitat for wintering waterfowl and both freshwater and estuarine fish. Attached aquatic plants often attain luxurient growth here during periods of clear water. Plankton and bottom-dwelling animals are also abundant.

5.22 Brackish ponds and lakes are less valuable for waterfowl and freshwater fish, but do provide nursery areas for numerous species of estuarine fish. There are a moderate number of attached aquatic plants in these water bodies. Plankton and bottom-dwelling animals are also numerous and diverse.

5.23 In saline ponds there are generally few attached plants and plankton, but bottom-dwelling animals are abundant. Numerous estuarine sport fish utilize these ponds. Under future without-project conditions, the acreage of these ponds would increase to the following by 2030: fresh, 141,600; brackish, 73,500; and saline, 99,000.

5.24 In summary, marsh ponds and lakes would increase markedly under future without-project conditions. All these increases would occur as the marsh adjacent to the ponds deteriorated. It must be remembered that the base of the estuarine food web is detritus, produced mainly in the marsh. Turner (1979) has shown that the Louisiana commercial inshore shrimp catch is proportional to the amount of intertidal wetlands and not to the amount of estuarine waters. Productivity studies show that a square meter of pond will produce 600 grams of phytoplankton per year (Day et al., 1973), while a square meter of marsh will produce 2,200 grams of marsh grass per year (Gosselink et al., 1979). Thus, as marsh disappears into ponds,

a vital part of the system is lost. Trends toward pond increase would be expected to continue from 2030 to 2080.

BAYS AND OPEN GULF

5.25 These habitat types presently form a large portion of the total acreage of the project-affected area: fresh bays cover 200,000 acres; brackish bays, 58,900 acres; saline bays, 53,800 acres; and open gulf, 804,000 acres. These bays are a major component of the dynamic estuarine complex that stretches from Morgan City to the gulf. Freshwater and estuarine forms use these bays in a constantly changing variety as salinities and temperatures change. The major change that would occur under future without-project conditions is the loss of 124,300 acres of fresh bay as the delta emerges in Atchafalaya Bay. The acreage of brackish and saline bays would be similar to 1980 conditions. As the delta grows, salinities in the western bays, portions of which are brackish now, would gradually decrease as more river water moves westward. Salinities in the Four League Bay area have been decreasing and the trend would be expected to continue for some time, but would eventually reverse and salinities in all of Terrebonne Parish would increase. It is difficult to predict changes in the system past 2030, but it is possible that the acreage of brackish and saline bays would stay the same and the amount of open gulf would decrease as the delta builds its way southward.

FLOOD-CARRYING CAPACITY

5.26 In 1927, a huge flood devasted much of the lower Mississippi River Valley. As a result, Congress passed the Flood Control Act of 1928, authorizing the Mississippi River and Tributaries project to provide for the safe passage of a project flood of 3 million cfs at the latitude of Old River. Because of its early history as a natural floodway, the Atchafalaya Basin became an integral feature of that project with its natural features supplemented by manmade levees, a channel to assist in obtaining the floodway's assigned flood-carrying capacity of 1.5 million cfs, and two outlets for passing the flood-waters out of the floodway system to the Gulf of Mexico. At present, the Atchafalaya Basin Floodway system is inadequate and can safely pass only 850,000 cfs, about 60 percent of its assigned capacity. It was assumed that under future without-project conditions, flood-carrying capacity would be maintained by the non-Federal action of raising the east and west protection levee. This could be done only at considerable social, environmental, and economic cost.

WATER QUALITY

5.27 The project-affected area can be divided into two main parts: the Atchafalaya Basin Floodway, that portion totally encompassed by a system of levees; and the areas outside of the levee system. Significant water resources in the Lower Atchafalaya Basin Floodway are affected by the annual stage variations of the Atchafalaya River, climate, biological activity, suspended sediments and siltation, water levels, circulation and distribution in backwater areas, land-use patterns, and physical modifications due to construction of borrow pits, canals, and other features. The State of Louisiana has designated the Atchafalaya River along its entire length for primary and secondary contact recreation and propagation of fish and wildlife, and as a domestic water supply above Bayou Boeuf. River water entering the floodway is turbid, high in suspended solids, high in dissolved oxygen, and rich in nitrogen and phosphorus. Much of the Atchafalaya River discharge remains intact and well aerated as it passes through the floodway.

5.28 Dissolved oxygen concentrations are one of the most important gauges of the project area's water quality and its ability to support a well-balanced aquatic fauna. Two separate phenomena create conditions under which reduced dissolved oxygen levels exist within the levee system: (a) rapid decomposition of newly inundated forest litter and herbaceous vegetation associated with periods of flooding and draining of overflow areas during high water levels and; (b) increased biological activity associated with warm summer temperatures, reduced flows, and receding water levels. The more severe dissolved oxygen reductions are closely associated with the peak flows of the spring season. Most of the extremely low dissolved oxygen concentrations during high water conditions in the floodway occur in backwater areas shielded from extensive wind action or with little or no water circulation due to manmade or natural obstructions.

5.29 Waters in the Lower Atchafalaya Basin Floodway are extremely rich in nutrients as compared to lakes outside the levees. However, light limitation due to mineral-induced turbidity may limit phytoplankton production within the levees. Areas outside the levee system which do not experience overbank flooding support higher standing crops of phytoplankton and have higher dissolved oxygen concentrations than areas within the levees which experience overbank flooding. Levels of chlorophyll a increase considerably within the levees during the warmer summer months. During this period, there is also a marked increase in ammonia-nitrogen values due to increased bacterial action primarily associated with bottom sediments.

5.30 The area within the levees exports a large quantity of nutrients (phosphorus and nitrogen) and fixed energy (in the form of dissolved organic carbon) via the Atchafalaya River and Wax Lake Outlets to the estuarine and marine waters. This export is important

in maintaining their productivity. The key to the high productivity of the Atchafalaya Basin Floodway is the short, efficient, bacteria-detritus food chain. Prolonged overbank flooding, with the inundation during rising stages of additional land areas containing herbaceous materials and forest litter, renews the carbon resources needed to drive the bacteria-detritus system.

5.31 Areas within the Lower Atchafalaya Basin Floodway are relatively free of heavy metals and organochlorine compounds in the water column, bottom sediments and biota. Pesticides are more widely present in the water column, sediments and/or biota in areas outside the levee system, or in areas within the levee system in the proximity of agricultural activity or subject to drainage from agricultural areas. Toxicants are also associated with industrial development in the Morgan City area.

5.32 Many factors would affect future water quality in the floodway. Reduction of water levels and water level fluctuations, and decreased inundation of backwater areas would result in a drying trend. This would affect the bacterial-detritus production and fixed carbon export. The introduction of sediment bearing waters into backwater areas in the floodway would cause further sediment deposition and loss of water area and depth. Physical modifications due to canal dredging and disposal of dredged material (spoil) would be expected to continue in the future irrespective of the implementation of any project features or management plans. Their effects would include stagnation, higher temperatures, and increased dissolved oxygen problems. Lower water levels in the floodway would likely allow for encroachment and expansion of residential and agricultural activities. These would further degrade water quality through loss of natural purificiation processes of the wetlands, residential discharges and runoff, runoff of sediments and nutrients from agricultural areas, and the permeation of agricultural pesticides into the abiotic compartment of the ecosystem and accompanying effects on biota.

NATURAL AND SCENIC STREAMS

5.33 The State of Louisiana has designated Bayou Penchant in Terrebonne Parish as "natural and scenic" (Louisiana Wildlife and Fisheries Commission, 1976). Bayou Penchant lies wholly within the privately-owned freshwater marshes and cypress-tupelo forests southeast of Morgan City between Bayou Chene and Lake Penchant (Plate 1). This bayou is protected by law from such actions as channelization, clearing and snagging, channel realinement, and reservoir construction. Water levels in the Bayou Penchant area have been slowly rising over the last several years as the flowline of the Atchafalaya River rises. Some trees along the bayou appear to be dying due to this flooding. Water levels would be expected to continue to rise under

future without-project conditions and this condition, coupled with the prevailing rate of land subsidence in the area, could adversely affect even more trees, thereby degrading the scenic qualities of the area.

NAVIGABLE WATERWAYS

5.34 The project-affected area abounds with navigable waterways. The Atchafalaya River and associated channels provide a water route extending the length of the basin. The shallow-draft Gulf Intracoastal Waterway traverses the area, intercepting rivers and bayous and crossing bays and lakes. Included in this waterway system are landside and floodside alternate routes to the Gulf Intracoastal Waterway that extend from Morgan City to Port Allen, Louisiana. This vital link for the towboat industry provides a shorter and faster route from the Morgan City area to and from the barge-fleeting areas on the Mississippi River. Within the Lower Atchafalaya Basin Floodway, navigation channels are maintained from the Atchafalaya River to the east and west protection levees' borrow pits. These allow access for crew boats, pleasure boats, and commercial fishermen. Other natural and manmade channels provide water access to practically all sections of the economic area. No extension of the network of major waterways is anticipated in the future.

FISHERIES

5.35 A good fisheries data base exists for the Lower Atchafalaya Basin Floodway, but somewhat less is known about the fisheries of the backwater area northeast of Morgan City. The estuarine dependent fisheries of the marshes are fairly well understood.

5.36 The Lower Atchafalaya Basin Floodway supports a diverse fishery. Annual overflow is the life blood of this complex. As the river water spreads over the lower basin each year, it picks up detritus and nutrients from the forest and these serve as the food source for numerous plankton, bottom-dwelling organisms, crawfish, and fish. These organisms are highly dependent upon the 347,000 acres of annually flooded forests as feeding, spawning, and living areas. Headwater and backwater lakes are also of vital importance to fishery productivity. More than 85 species of fish occur in the leveed floodway and they can be present in amounts exceeding 1,000 pounds per acre (Sabins, 1977). Crawfish, also abundant, are a primary food for many fish as well as other animals. A large recreational fishery exists, having an annual harvest of 2.9 million fish (mostly bass, crappie, and other sunfish) and 1.6 million pounds of crawfish reported for the 1971-1974 period (Soileau et al., 1975).

5.37 Commercial fishing activities are also important. Crawfish, buffalo, and catfish comprise over 90 percent of the value of the catch, which was worth 2.8 million dollars in 1979. During the period 1965 to 1979, the average annual harvests were as follows: crawfish, 13.6 million pounds; catfish, 2.2 million pounds; and buffalo, 1.1 million pounds. Crawfish are consumed locally and internationally and demand continues to increase. Many people living within 50 miles of the project area engage in full- or part-time commercial fishing and this work, plus processing and wholesaling of fish, crawfish, and prepared products, provides employment for thousands of people.

5.38 Fish sampling studies (US Department of Agriculture, 1978) in the backwater area northeast of Morgan City indicated that bayous averaged 165 pounds of fish per acre with few sport fish and large populations of shad and carp. Lake Verret averaged slightly over 160 pounds per acre and supported large numbers of sport fish with a fair population of commercial fish. Lake Verret is occasionally opened to commercial fishing and catches are on the order of 200,000 pounds annually. Some crawfishing occurs in the swamps in the spring. The probable reason that the backwater area is far less productive than the leveed floodway is that it does not receive any river overflow with its nourishing and flushing actions. The existing swamps in the backwater area furnish vital nutrients to the aquatic system.

5.39 The marsh complex supports an extensive sport and commercial fishery. The most valuable commercial species are shrimp and menhaden. In the 1963 to 1978 period (1963-73 for Hydrologic Units 6 and 7), the average annual harvest attributed to the project-affected area was 47.8 million pounds of shrimp worth 46.45 million in 1978 dollars; 173.2 million pounds of menhaden worth 7.5 million in 1978 dollars; and 2.2 million pounds of oysters worth 2.8 million in 1978 dollars. Seatrout are the most sought-after estuarine sport fish with nearly 6,500,000 being caught in Louisiana waters during 1979. Red drum are the second most sought-after; 1,450,000 were caught in 1979. Atlantic croaker are harvested in large numbers (6,000,000 in 1979) and southern flounder and sheepshead are also popular. The total estimated number of participants per year in the Louisiana estuarine recreational fishing is 500,000 (US Department of Commerce, 1980). Sport shrimping is also a popular pastime. Juneau and Pollard (1981) showed a recreational shrimp catch in 1978 of nearly 250,000 pounds of white shrimp and nearly 200,000 pounds of brown shrimp. Both the sport and recreational fishing provide significant financial benefits to the local and national economy. The marsh complex acts as a nursery area for all the above-mentioned fish and shellfish as well as for blue crabs and numerous smaller fish.

5.40 The fishery resources in the Lower Atchafalaya Basin Floodway under future without-project conditions would be drastically reduced due to decreases in aquatic habitat caused by sedimentation and lowering of water levels (Table 6-11). The amount of forest flooded

during an average year would drop from 374,000 acres to 247,000 acres. Increases in pesticides and turbidity would be caused by the dramatic increase in agricultural activity that would occur. The pesticides would be concentrated in the food web and would adversely impact aquatic organisms. As a result of all the above factors, it is estimated that crawfish harvest could drop by 40 percent. Catches of sport fish would also decrease by approximately 40 percent. (Methodology for these calculations is described in Section 6 of Appendix A.)

5.41 It is difficult to predict the future of fishery resources of the backwater area. Rising water would cover more bottomland hardwoods and would reduce the amount of ground cover which could decrease the amount of detritus available to sustain fishery resources. Increased agricultural activity would increase pesticides and turbidity which would adversely impact fishery resources. On the other hand, rising waters would create more aquatic habitat, and as the cypress trees were cut, rooted aquatic plants could provide food and hiding and spawning areas for fish. Thus, the fishery resource could increase.

5.42 Cypress-tupelo swamps could start growing in what is now marsh in areas southwest of Morgan City as sedimentation raises ground levels. These swamps would help replace the nutrients, detritus, and aquatic habitat lost as Lower Atchafalaya Basin Floodway swamps become filled with sediment. As described earlier, marshes are eroding and subsiding and being converted into ponds. This would normally decrease the fishery as the detritus that sustains it disappears. However, the lost marshes would be replaced by newly developing deltaic marshes in the bay. Calculations of the possible harvest of shrimp and menhaden in the project-affected area indicate that by 2030, the harvest might be slightly less than present levels.

5.43 It is extremely difficult to estimate future without-project conditions trends in fisheries from 2030 to 2080. It is probable that the 1980 to 2030 decline in the Lower Atchafalaya Basin Floodway would continue. The fate of the fisheries resource in the backwater area and marsh complex is more difficult to predict, but it would decrease. As Wax Lake Outlet captured more of the Lower Atchafalaya River flow, salinity intrusion would hasten the demise of the Terrebonne Parish marshes.

WILDLIFE

5.44 Wildlife resources occur abundantly throughout the forests, swamps, lakes, bayous, and marshes that make up the basin. Each year large flocks of migratory waterfowl winter in the overflow swamps and lakes of the floodway, and large numbers of resident water birds use

the area all year long. Usage of marshland areas by these species is also heavy. In the drier parts of the area, large populations of white-tailed deer may be found along with small mammals, such as swamp rabbits and squirrels. The area also contains large numbers of aquatic and semi-aquatic mammals, such as the river otter, muskrat, nutria, raccoon, and mink. Many species of salamanders, frogs, lizards, snakes, and turtles are also present. The area serves as the probable home of several endangered species. The significance of these wildlife resources is large from the standpoints of ecology, recreation, and commercial trapping. Each year thousands of persons are attracted to the area to pursue both consumptive and nonconsumptive uses of the resources. Under future without-project conditions there would be a highly significant decrease in wildlife due primarily to land clearing within the Lower Atchafalaya Basin Floodway.

ROOKERIES

5.45 Numerous rookery areas for sea birds and wading birds have been identified within or near the project-affected area (Portnoy, 1977; Kennedy, 1977; LeBlanc, 1981) (Figure 5-2). Two of these, located on dredged material islands in Atchafalaya Bay, have been utilized by terns and skimmers. The other rookeries, located to the north in and around the leveed portion of the floodway, are utilized by various species of herons, egrets, ibis, and the anhinga. The majority of these rookery areas are found in forested swampland. Several of these areas have been used by 20,000 or more individual birds during a single breeding season. Under future without-project conditions, a number of these rookeries would disappear due to a decline in the acreage of feeding habitat for the birds that use them.

AUDUBON SOCIETY BLUE LIST SPECIES

5.46 The "Blue List" published by the National Audubon Society is a list of bird species that are showing indications of noncyclical population decline or range contraction, either locally or throughout their range. This list, compiled by interested observers throughout the country, serves as an early warning to indicate those species that might be in danger of extinction in the future. The 1979 Blue List (see Appendix G) lists 64 species. The normal range of 50 of these includes the project area. Certain species, such as the white pelican, king rail, and gull-billed tern, are abundant in the project area. Gull-billed terns are known to have large nesting colonies in the coastal part of the Atchafalaya Basin, which is important to the preservation of these species. Under future without-project conditions, those Blue List species living in forest or more saline marshland habitats would decline in numbers.

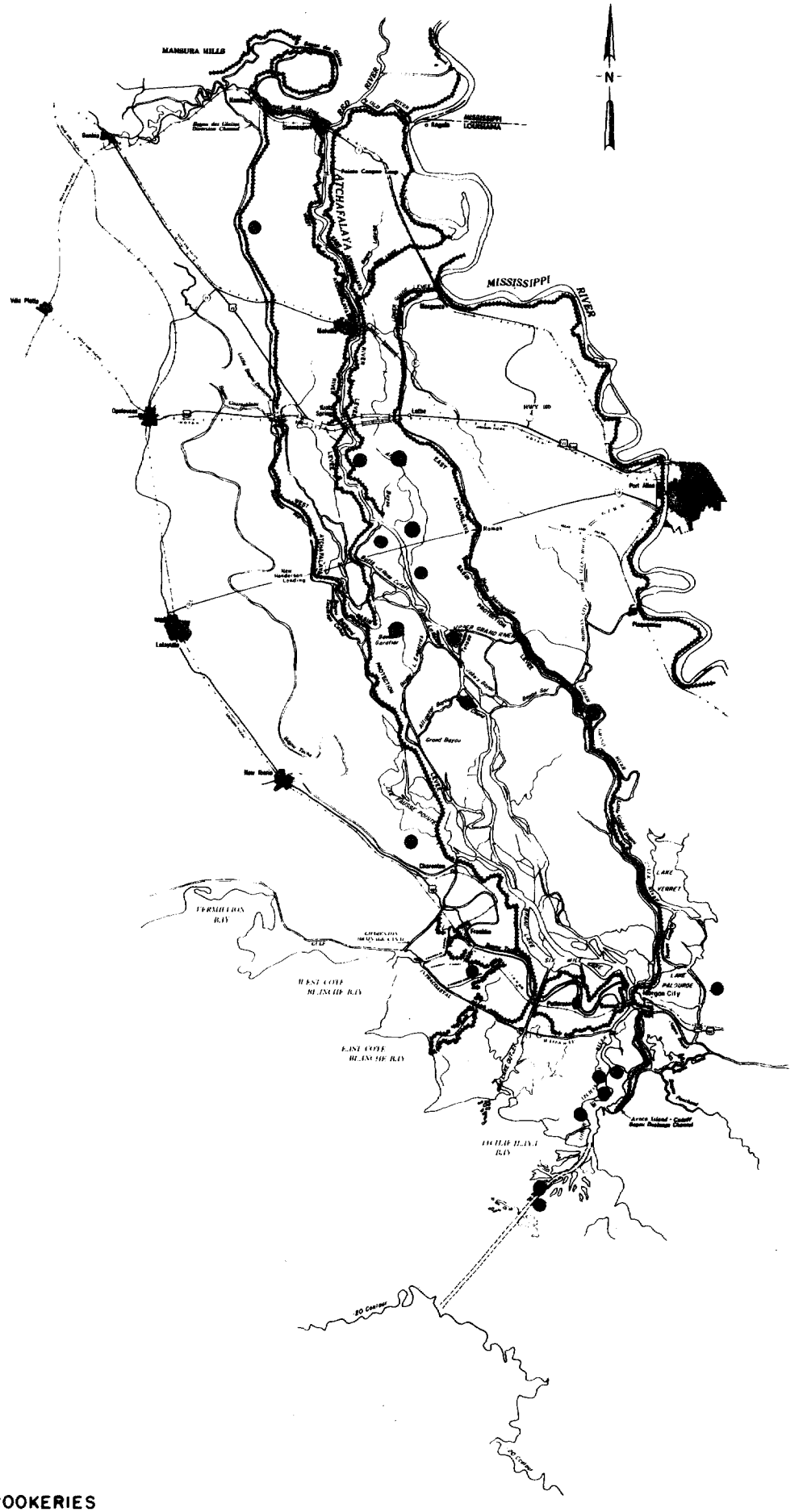


Figure 5- 2 BIRD ROOKERIES
● SITE LOCATION

ENDANGERED AND THREATENED SPECIES

5.47 Fourteen endangered and two threatened species of animals occur or might be expected to occur within the project area (US Fish and Wildlife Service, personal communication; US National Marine Fisheries Service, personal communication). The threatened species include the loggerhead and green sea turtles. The endangered species include the Florida manatee that may occur in coastal waters; the leatherback, and Kemp's ridley sea turtles that may be found in Atchafalaya Bay and along the gulf coast; the ivory-billed woodpecker that has been sighted in the Atchafalaya Floodway; the Arctic peregrine falcon that migrates through the area and winters along the gulf coast; the bald eagle, a winter resident in the lower parts of the project area; the Eskimo curlew that may pass through during its northward migration in the spring; the brown pelican that occurs along the gulf coast; Bachman's warbler that may be a summer resident of the bottomland hardwood forests of the area; the Florida panther that has been sighted in the southern basin near the Attakapas Wildlife Management Area (Watson, personal communication) and the sei, finback, and sperm whales which may occur along the gulf coast. Population levels of all these species are very low. Under future without-project conditions, it is probable that the ivory-billed woodpecker, Bachman's warbler (if it now exists), and the Florida panther would cease to exist within the project area. Other species might decline in numbers or disappear as well.

RECREATIONAL FEATURES

5.48 The project-affected area offers diverse recreational opportunities. The two major recreational activities, hunting and fishing, are sustained by the great abundance of wildlife and fishery resources of the area.

5.49 Approximately 80 percent of the project-affected area is in private ownership. More than 250 private hunting clubs either own or lease lands having permanent camps in the northern portion of this area (Miller, personal communication). Public hunting is restricted more to state-owned lands, such as the Attakapas and Atchafalaya Delta Wildlife Management Areas or to public water bodies.

5.50 Fishing and crawfishing occur throughout the area but are more concentrated in the southern part.

5.51 Public access is achieved by public or commercial boat ramps. Many of the commercial-type ramps adjoin a totally commercial operation, offering guide service, fishing bait and tackle, and groceries. Launching fees are nominal. Most public boat ramps are parish-maintained and offer free launching and parking.

5.52 Several commercial campgrounds are located in the project-affected area. Campgrounds generally offer sites having electrical hookups, water and sanitation facilities and, in some instances, boat-launching ramps to enter the basin.

5.53 The Lower Atchafalaya Basin Floodway provides a focal point for the pursuit of many nonconsumptive recreational activities. Nature seekers engage in canoeing, photography, nature study, and exploring. Commercial operations catering to the nature enthusiast are on the rise and offer such services as basin tours and guided canoe outings.

5.54 Although a variety of recreational activities are sustained by the project-affected area and recreational pursuits are increasing, the area's full recreational potential has not been fully realized. There would be, however, a significant decrease in recreational opportunities under future without-project conditions. A loss of about 49,000 annual user-days worth $1,590,000 would occur by 2030.

WILDLIFE REFUGES AND MANAGEMENT AREAS

5.55 One national wildlife refuge and 11 state wildlife management areas are located within the project area, primarily in the Red River backwater area. The majority of the approximately 322,000 acres of primarily bottomland hardwood forests making up these areas is in public ownership. These forests provide recreational opportunities to thousands of persons annually, and provide needed habitat for game and nongame species of wildlife, such as deer, squirrels, rabbits, songbirds, waterfowl, and others. Two of the 11 state-owned wildlife management areas lie within the project-affected portion of the study area (Plate 1). They are the Atchafalaya Delta and Attakapas Wildlife Management Areas.

5.56 The Atchafalaya Delta Wildlife Management Area is comprised of some 125,000 acres of emergent and semi-emergent delta lands at the mouth of the Atchafalaya River, containing fresh to intermediate marshlands, bayous, shallow bay areas, and extensive mudflats. This area contains high quality habitat for wintering waterfowl and is one of the best duck hunting locations in the state.

5.57 The Attakapas Wildlife Management Area is comprised of some 26,000 acres of mainly accretion lands located in Grand Lake. Much of the area is subject to seasonal overflow from the Atchafalaya River. The area contains cypress-tupelo swamp and early successional stage bottomland hardwood forests. The most important game animals in the area are deer, swamp rabbits, squirrels, and wood ducks. In addition to hunting, both fishing and crawfishing are important activities in the area.

5.58 Under future without-project conditions, the size and habitat quality of both of these areas would increase due to plant succession, sedimentation within the floodway, and delta development in Atchafalaya Bay. Public usage would also increase.

TIMBER

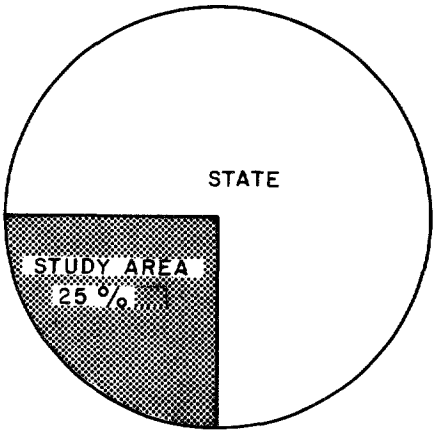
5.59 Commercial forests comprise almost 40 percent of a 19-parish economic study area (Figure 5-3). In fact, 25 percent of the commercial forests and 51 percent of the bottomland hardwood forests of the state are located in this economic study area. Although this area abounds in trees, commercial forests are decreasing faster than the state average. During the period 1964-1974, commercial forests decreased 15.7 percent, compared with a 9 percent decrease in the state. Sixteen of the 19 parishes had a decrease in commercial forest areas from 1964-1974. The total stumpage value of harvested timber amounts to only a small portion of the state's total timber value due to high value and volume of pine produced in other areas. However, the economic study area accounts for over 70 percent of the cypress and 41 percent of the cottonwood and willow harvested in the state. This area accounted for 36 percent of all hardwood timber harvested in the state in 1977. In 1976, the total stumpage value of harvested timber in the economic area was about 13.5 million dollars, or 11.2 percent of the state total, with about 69 percent of this income ascribable to pine and pulpwood pine. About two-thirds of the total study area timber sales occurred in the northern parishes of Caldwell, LaSalle, and Ouachita. Under future without-project conditions, timber resources would decrease significantly as land clearing continued and harvest of the existing cypress-tupelo forest progressed.

OIL, GAS, AND MINERALS

5.60 While no statistics are collected for the Atchafalaya Basin or backwater area northeast of Morgan City specifically, the following data for the 19-parish economic area and state demonstrate the importance of oil, gas, and mineral production.

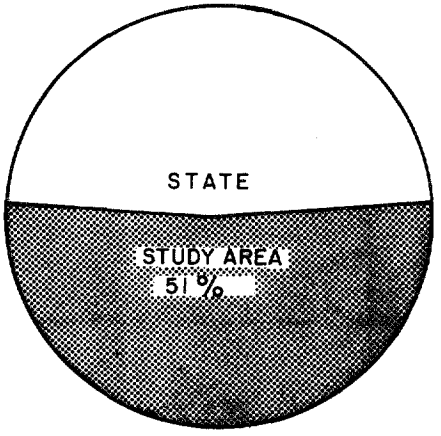
5.61 Minerals produced in the 19-parish economic area include petroleum, natural gas, natural gas liquids, salt, sulfur, sand, and gravel, shell, clay, and lime. By-products of the natural gas and shell include carbon black and cement. Petroleum production in Louisiana increased from 104 million barrels in 1940 to 209 million in 1950, to 401 million barrels in 1960, and to 907 million in 1970. Its value increased from $107 million in 1940 to $3,062 million in 1970. The preprint of the Bureau of Mines Minerals Yearbook for 1974 reported crude petroleum production in Louisiana to be 737 million

COMMERCIAL FORESTS



25 PERCENT OF STATE'S COMMERCIAL FORESTS ARE LOCATED IN THE STUDY AREA, 1974

BOTTOMLAND HARDWOODS



51 PERCENT OF STATE'S BOTTOMLAND HARDWOODS ARE LOCATED IN THE STUDY AREA, 1974

SOURCE: U.S. DEPT. OF AGRICULTURE, "FOREST STATISTICS FOR LOUISIANA PARISHES, 1975."

FIGURE 5-3 COMMERCIAL FOREST AREAS

barrels valued at $4,812 million. Natural gas production in the state increased from 343 million cubic feet (mmcf) valued at $64 million in 1940 to 7,754 mmcf valued at $2.38 billion in 1974. Oil and gas have accounted for almost 90 percent of the value of the state's mineral production. In 1974, the value of mineral production in the area's four coastal parishes alone totaled $3.2 billion or 5.8 percent of the United States total. More than any other single factor, the expansion of mineral production has led to the area's employment, income, and population growth. Only six of Louisiana's 64 parishes have unemployment levels below 6 percent. Five of them are in south Louisiana and three of the five (Iberia, Lafourche, and Terrebonne) are coastal parishes of the Atchafalaya economic area. The 1970 census reported that direct employment in mineral production accounted for 14 percent of the total in coastal parishes and 8 percent in the economic area overall. Since the late 1950's some of the construction associated with mineral production has declined; nevertheless, the 1970 census indicated that the three parishes producing the greatest quantities of oil and gas (Lafourche, St. Mary, and Terrebonne) also were the three parishes with median family incomes exceeding the state's median family income. Under future without-project conditions, extraction of oil, gas, and minerals would continue but would eventually decrease in importance.

CULTURE OF THE BASIN

5.62 The project-affected area has a rich cultural heritage. The unique folk culture that developed there attests to that fact. The area was settled both by English speakers and French-speaking Acadians who developed techniques for curing moss, removing cypress logs, and catching crawfish (Comeaux, 1972).

5.63 The Acadians who settled in the area abandoned agriculture and learned to utilize the swamps' resources. Folk culture in the area did not develop in isolation, but adjusted through time to new technology and demands. At present, the heart of the swamps has largely been abandoned and the inhabitants have moved to the edges of the Atchafalaya Basin Floodway. This abandonment was due to the loss of wetlands caused by levee construction and sedimentation, discovery of oil and gas in the basin, and the technological advances and conveniences of the 20th century (Comeaux, 1972). However, there remains today an abundance of folk behavior and tradition adapted to swamp utilization which comprises an "Atchafalaya Basin Culture." The rich cultural heritage of the project-affected area offers great scientific, educational, and interpretative potential.

5.64 Under future without-project conditions, the continuing sedimentation and draining of the swamps would adversely impact the swamp dependent economic base, and thus, the lifestyle of the people who

live on the edges of the floodway. The deterioration of the economic resource base would have far-reaching effects upon folk culture. Few people presently live in the floodway, since the trend has been a movement to the margins of the basin where employment opportunities have increased. It is expected that this trend would continue.

NATIONAL TRUST PROPERTIES

5.65 There are no National Trust properties in the project-affected area.

NATIONAL REGISTER PROPERTIES

5.66 The National Register of Historic Places as published in the "Federal Register," dated 6 February 1979, and the monthly supplements through 27 October 1981, have been consulted and only two cultural resources, 16SM45 and 16SMY52, located within the Lower Atchafalaya Basin Floodway have been determined eligible for the National Register (US Department of Interior, 1979). The Nutgrass site, 16SM45, is an important shell midden located on the west bank of the Morgan City-Port Allen Route of the Gulf Intracoastal Waterway south of Belle River Landing, Louisiana. Subsequent to its determination of eligibility to the National Register, the Nutgrass site was protected from erosion by placement of stone on the bank and adjacent underwater slope by the US Army Corps of Engineers in 1975. The Avoca Island Pumping Plant Number 1, 16SMY52, is located on the east bank of Bayou Shaffer south of Morgan City, Louisiana. Built between 1910 and 1914, the plant was one in a system of three pumping stations which drained the 16,000 acres of Avoca Island. The property was investigated during the intensive cultural resources survey of the East and West Atchafalaya Basin Protection Levees conducted by the University of Southwestern Louisiana in 1979-80 under contract to the US Army Corps of Engineers, New Orleans District (Gibson et al., 1980). No other cultural resources in the project-affected area are presently listed in or have been determined eligible for inclusion in the National Register. The draft report on the findings of the cultural resources survey of the East and West Atchafalaya Basin Protection Levees identified 12 cultural resources in the survey corridor as significant and eligible for inclusion in the National Register. These 12 resources include the Nutgrass archeological site, 16SM45, which had previously been determined eligible for the National Register and the Avoca Island Pumping Plant Number 1, 16SMY52, which has subsequently been determined eligible to the National Register. In addition, the intensive cultural resources survey of the other project features of the selected plan, which will be conducted during the next stage of planning, may locate additional cultural resources eligible for inclusion in the National Register.

5.67 Under future without-project conditions, any effects on sites 16SM45, 16SMY52, and other possibly significant sites identified by the cultural resources survey due to the enlargement of the East and West Atchafalaya Basin Protection Levees would be addressed in accordance with existing laws and regulations.

ARCHEOLOGICAL RESOURCES

5.68 Over 252 prehistoric and historic archeological sites are recorded within the project-affected area. The recorded prehistoric sites in the basin range from small midden deposits to large ceremonial mound centers. However, the recorded sites represent only a biased and incomplete sample of the archeological resources suspected to exist. The known site locations are largely a function of where cultural resources surveys have been undertaken. The inaccessibility of many areas of the swamp, subsidence, and the heavy sedimentation rate in the lower floodway have and will continue to influence man's ability to locate, identify, and evaluate cultural remains. Therefore, it is reasonable to assume that many as yet unrecorded archeological resources exist. Moreover, the considerable number of ship disasters and the Civil War-related vessel sinkings in the project-affected area indicate the existence of subsurface or underwater ship remains.

5.69 Under future without-project conditions, archeological resources would be adversely affected. Obscuration of sites by sedimentation, unregulated development, and the widening and deepening of the Atchafalaya River by natural processes would continue to impact the archeological resources of the project-affected area.

NATIONAL REGISTER OF NATURAL LANDMARKS SITES

5.70 The National Natural Landmarks Program is administered by the National Park Service of the US Department of Interior. Its purpose is to identify and encourage the preservation of areas that reflect the ecological and geological character of the United States and to strengthen an appreciation of natural history and concern with conservation. Designating an area as a national landmark does not affect the ownership of the site, nor does it allow public access. It merely seeks to foster a greater awareness of one's national heritage and allows agencies or individuals to consider its special significance. The Lower Atchafalaya Basin Floodway has been studied for inclusion on this registry. Preliminary evaluation has revealed that it probably has significance as a natural landmark. Further evaluation will be carried out subsequent to completion of this study. Future without-project conditions would degrade much of the lower floodway; thus,

less land would be available for inclusion as a potential national landmark.

OPEN SPACE

5.71 The project-affected area south of I-10 contains the largest contiguous tract of land in the State of Louisiana that is roadless and in a semi-natural condition. This open space serves as a valuable retreat from the pressures of urban life for thousands of persons who reside in the nearby cities of Lafayette, Baton Rouge, New Orleans, and Houma, Louisiana, as well as for those in the smaller towns of the area. Such semi-natural open space is becoming increasingly rare in south Louisiana due to the rapid industrialization and expansion of agriculture and the attendant increase in population, as well as to the demands on the available open space for home construction, roads, and related facilities. These demands would increase under future without-project conditions and open space would decrease proportionately. Rising water levels in the backwater area would preserve open space there under future without-project conditions.

AIR QUALITY

5.72 Air quality within the project-affected area is generally good except in the vicinity of certain industrial sites located near Krotz Springs and along the Teche and Bayou Black Ridges. Under future without-project conditions, this would change as increasing development takes place within the lower floodway and further industrialization occurs along the Baton Rouge-New Orleans corridor to the east. These changes would tend to degrade air quality. On the other hand, rising water levels in the backwater area around Morgan City could serve to force the existing industries there to relocate elsewhere. This would improve air quality in the immediate area.

ESTHETIC VALUES

5.73 The project-affected area is noted for having high esthetic values, although in many areas these values have been severely degraded by the construction and operational activities of the oil and gas industry, as well as extensive sedimentation, which has filled in many former open water areas. Many parts of the area are riddled with a maze of access and pipeline canals that have destroyed the wilderness nature of the swamplands. Numerous portions remain, however, in a scenic, semiwilderness state. Under future without-project

conditions, the esthetic qualities of the project-affected area would continue to deteriorate.

UNDEVELOPED LAND

5.74 The project-affected area includes several hundred thousand acres of undeveloped land, primarily marsh and forest. Some of this land could be converted immediately to agricultural land while, in other cases, the probability of flooding is so great that conversion for agricultural developments is not economically feasible. In most of the project-affected area, the primary development alternative would be for the purpose of raising soybeans. In the backwater area northeast of Morgan City, in particular in the vicinity of Bayous Boeuf and Black, the primary development potential is for conversion to industrial purposes. Under future without-project conditions, most existing undeveloped bottomland forest would eventually be developed. Rising water levels would prevent forests in the backwater area from being cleared.

PROPERTY OWNERSHIP

5.75 In the Lower Atchafalaya Basin Floodway, it is estimated that in excess of 265,000 acres, approximately 60 percent of privately-owned land, is vested in 13 major property owners. Each of these owners controls acreage ranging from 5,000 acres to more than 44,000 acres. The remaining privately-owned land, approximately 175,000 acres, is controlled by some 3,200 landowners. In addition to the privately-owned land, the state has claim to approximately 150,000 acres. This land ownership pattern would probably continue under future without-project conditions.

Section 122 Items

5.76 The following items are not considered to be significant resources. However, legal requirements of Section 122, 1970 Rivers and Harbors Act, Public Law 91-611, require addressing the impacts of each proposed plan upon these items. The following paragraphs explain briefly what these refer to and how they relate to the project-affected area.

NOISE

5.77 The project-affected area, because of the semiwilderness nature of much of it, is a relatively noise-free environment. However, few areas are totally noise-free. The activities of the oil and gas industry, water-based shipping industry, and sport and commercial fishermen occur throughout the area. Much of the noise that does occur is due to boat traffic originating with these groups. At times, even in the most remote parts of the area, noise levels are high. Under future without-project conditions, noise levels would increase due to the increasing development that would occur.

DISPLACEMENT OF PEOPLE

5.78 Alternative plan impacts as they relate to the displacement of people are concerned with the direct and indirect consequences of plan implementation on areas of existing habitation. An example of a direct plan impact would be those persons forced to move because they inhabit lands required for project construction. An example of an indirect impact would be individuals induced to move as a result of altered flood conditions caused by plan implementation. Under future without-project conditions, displacement of people would increase from both direct and indirect consequences. There would be relocations from construction of the floodway guide levees, which is part of the future without-project condition, as well as from rising water levels in the backwater area northeast of Morgan City.

COMMUNITY COHESION

5.79 The unique cultural heritage of the project-affected area is linked directly to a way of life based on swamp resource exploitation. The preservation of this traditional lifestyle and the continued existence of some ethnic groups and folk society is therefore dependent on preservation of the swamp habitat. Under future without-project conditions, there would be a loss of the habitat necessary to provide the occupations that support the traditional lifestyle.

COMMUNITY GROWTH

5.80 The potential for community growth exists in the Morgan City and vicinity area. This growth is directly linked to the continued viability and expansion of the Morgan City oil and gas-related industrial complex. Under future without-project conditions, rising water levels in the backwater area could adversely affect the

expansion and even the existence of some facilities, thereby retarding the growth of the area.

LOCAL GOVERNMENT FINANCE, TAX REVENUES, AND PROPERTY VALUES

5.81 The area of local government finance is concerned with items such as the tax base, property values, and tax revenues. Each of these, and other items, are important because they impact the financial condition of local governmental units. Financial soundness is important because it often determines the level and quality of the necessary public services provided by local governments. Under future without-project conditions, there probably would be a slight increase in property values on forestland converted to cropland and a corresponding potential for increase in property tax revenue. On the other hand, rising water levels in the backwater area could force the relocation of industrial facilities and thereby remove the tax base.

PUBLIC SERVICES AND FACILITIES

5.82 The area of public services and facilities is concerned with the ability of local units of government to provide the basic public services; e.g., sanitation, water supply, education, and police protection. Under future without-project conditions, it is not expected that the ability to provide such services would be significantly altered.

BUSINESS AND INDUSTRIAL ACTIVITY AND REGIONAL GROWTH

5.83 Within the project-affected area, the industrial complex located in and around the Morgan City area holds the greatest potential for spurring regional growth. As the focal point for the manufacture of items used in the exploration and production of oil and gas resources in the Louisiana gulf region, growth of this industrial complex is directly linked to national and international developments in the energy-related industries. Under future without-project conditions, the growth potential for this area could be greatly hampered as a result of rising water levels and increased flood hazards in the backwater area northeast of Morgan City.

EMPLOYMENT AND LABOR FORCE

5.84 In the 19-parish economic study area, employment in 1970 was concentrated in trade, services, manufacturing, government,

construction, agriculture, forestry, fisheries, and mining. Economic area employment was more concentrated in agriculture, forestry, fisheries, and mining in 1970 relative to comparable statewide data. About 24.1 percent of the economic area civilian labor force was employed in these industry sectors while the statewide average was about 15.6 percent. Under future without-project conditions, there would be a minor increase in employment resulting from raising the East and West Lower Atchafalaya Basin Protection Levees. There also would be some small increase in agricultural employment as forestland became converted to cropland, and commercial fishing employment would decrease because the habitat necessary for fish populations would be lost. There could also be a loss of jobs in the manufacturing sector if rising water levels in the backwater area force portions of the Morgan City industrial complex to relocate.

DISPLACEMENT OF FARMS

5.85 Displacement of farms refers to the forced abandonment of existing farms due to the completion of project features or conditions. Under future without-project conditions, some displacement of farms in the backwater area northeast of Morgan City could occur due to rising water levels associated with enlargement of the Atchafalaya delta.

VECTORS

5.86 Vectors in the project area include a variety of mosquitoes with the most common genera being Anopheles, Aedes, and Culex. Some species inhabitat a wide variety of habitats while others are more restricted. Some species such as Aedes sollicitans breed only in temporary water while others such as Culex salinarius require permanent water for breeding. The most common vector borne diseases are infectious equine anemia, anaplasmosis and Venezuelan equine encephalitis.

6. ENVIRONMENTAL EFFECTS

6.1 This section describes the effects of each detailed plan on the previously described significant resources and serves as a supplement to the "Comparative Impacts of Alternatives" table in Section 4. It should be noted that due to the dynamic nature of the project area, any attempt to assess impacts in a quantitative matter beyond the year 2030 (2036 for economic assessments) was deemed inappropriate and highly speculative except for projection of the amount of land clearing for agricultural conversion that might occur in the post-2030 period. In discussing the impacts of each plan on most significant resources, the impacts that could occur during the first 50 years of project life are examined in detail, and a brief, nonquantitative description of possible impacts during the final 50 years follows. In certain appropriate cases, impacts throughout project life are treated as a unit. Major impacts of proposed project features, such as channel training, management units, environmental easements, etc., are discussed first and are followed by a brief discussion of impacts due to operation and maintenance of these features. Impacts of mitigation measures are also discussed. At the end of each significant resource section, a brief discussion of impacts due to operation and maintenance of existing project features is included. Details of direct construction impacts or operation and maintenance impacts of the various plans are shown in Tables 4-4, 6-1, 6-2, 6-3, 6-4, 6-5, and 6-6; and changes in acreage of habitat types are shown in Table 6-7. Plates 5 through 18 show the locations of the various construction features. For a better comprehension of plan impacts, the reader may wish to refer to these tables and plates as remaining sections of this report are read. It should be noted that, for Plans 4 and 9, this section does not attempt to discuss potential impacts of measures that could eventually be implemented to solve backwater flooding problems. These would be discussed in the future in a supplement to this EIS.

6.2 It should be noted that four major data gaps exist that may have influenced the following impact analysis. The first is the lack of detailed data to enable the separation of the effects of the two sediment control features that were originally proposed, distributary realinements and sediment traps. The effects of these features were treated together in making land-use projections for the future. Since sediment traps were eliminated for environmental reasons from the final three plans, land-use projections overestimate the benefits to be gained from sediment control and do not fully assess loss of water bodies. However, relative comparison of the detailed plans is possible.

6.3 A second data gap is incomplete technical information concerning all possible impacts of management units upon the aquatic and terrestrial environment. In concept, these units should be highly valuable in preserving the aquatic resources of the basin, but in

TABLE 6-1

DIRECT CONSTRUCTION IMPACTS OF FLOODWAY PROTECTION LEVEES (ACRES)
1972 TO 1980 AND 1980 ON

	All Plans	Plan 2 FWO		Plan 4 EQ		Plan 7 NED		Plan 9 R	
	1972 to 1980	1980 on	Total	1980 on	Total	1980 on	Total	1980 on	Total
RIVER LEVEES									
Early successional BLHW[1/]	-20	-250	-270	-160	-180	-150	-170	-150	-170
Late successional BLHW	-10	-20	-30	-10	-20	-10	-20	-10	-20
Open land	-40	-	-40	-	-40	-	-40	-	-40
Bayous, canals, and borrow	+70	+270	+340	+180	+250	+160	+230	+160	+230
FLOODWAYS LEVEES									
Early successional BLHW	-1,400	-730	-2,130	-720	-2,120	-690	-2,090	-670	-2,070
Late successional BLHW	-2,050	-5,540	-7,590	-4,020	-6,070	-3,630	-5,680	-3,840	-5,890
Cypress-tupelo	-1,460	-880	-2,340	-720	-2,180	-700	-2,160	-710	-2,170
BLHW-CT mix[2/]	-10	-20	-30	-20	-30	-20	-30	-20	-30
Open land	+1,190	-	+1,190	-150	+1,040	+530	+1,720	+90	+1,280
Bayous, canals, and borrow	+3,720	+7,190	+10,910	+5,620	+9,340	+4,510	+8,230	+5,140	+8,860
LEVEES OUT OF FLOODWAY									
Early successional BLHW	-170	-110	-280	-50	-220	-50	-220	-50	-220
Late successional BLHW	-360	-270	-630	-120	-480	-140	-500	-140	-500
Cypress-tupelo	-40	-	-40	-1,100	-1,140	-1,260	-1,300	-1,350	-1,390
Open land	0	+100	+100	+140	+140	+140	+140	+170	+170
Fresh marsh	-100	-	-100	-170	-270	-200	-300	-200	-300
Bayous, canals, and borrow	+620	+160	+780	+1,420	+2,040	+1,500	+2,120	+1,360	+1,980

[1/] Bottomland hardwood.

[2/] Bottomland hardwood - cypress-tupelo mix.

TABLE 6-2

DIRECT CONSTRUCTION IMPACTS OF CHANNEL WORK (ACRES)

	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
CHANNEL TRAINING ATCHAFALAYA RIVER[1/]				
Early successional BLHW[2/]	0	+2,670	+2,670	+2,670
Late successional BLHW	0	-1,000	-1,000	-1,000
Cypress-tupelo	0	-1,730	-1,730	-1,730
Borrow	0	+60	+60	+60
CHANNEL TRAINING LOWER ATCHAFALAYA RIVER[3/]				
Early successional BLHW	0	0	+1,510	+1,510
Cypress-tupelo	0	0	-200	-200
Fresh marsh	0	0	-700	-700
Riverine	0	0	-610	-610
BANK STABILIZATION				
Late successional BLHW	0	-130	-130	-130
Cypress-tupelo	0	-120	-120	-120
Riverine	0	+250	+250	+250

[1/] All plans 2,550 acres early successional BLHW to open to early successional BLHW.
[2/] Bottomland hardwood.
[3/] All plans 220 acres early successional BLHW to open to early successional BLHW.

TABLE 6-3

DIRECT CONSTRUCTION IMPACTS OF OUTLETS WORK (ACRES)

	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
OUTLET CHANGES[1]				
Early successional BLHW[2]	0	-90	-90	-180
Cypress-tupelo	0	-20	-20	-60
Riverine	0	0	0	+240
Borrow	0	+110	+110	
WIDEN WAX LAKE OUTLET OVERBANK				
Early successional BLHW	0	+650	+650	+650
Late successional BLHW	0	-590	-590	-590
Cypress-tupelo	0	-180	-180	-180
Open land	0	-80	-80	-80
Fresh marsh	0	-90	-90	-90
Borrow	0	+290	+290	+290
INCREASE SEDIMENT WAX LAKE OUTLET				
Early successional BLHW	0	-400	0	0
Riverine	0	+400	0	0

[1] Plans 4 and 7 - 190 acres early successional BLHW to open to early successional BLHW, Plan 9 - 180 acres early successional BLHW to open to early successional BLHW.

[2] Bottomland hardwood.

TABLE 6-4

DIRECT CONSTRUCTION IMPACTS OF SEDIMENT CONTROL, MANAGEMENT UNIT, AND RECREATION FEATURES (ACRES)

	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
SEDIMENT CONTROL				
Early successional BLHW[1/]	0	+440	+440	+440
Late successional BLHW	0	-710	-710	-710
Riverine	0	+270	+270	+270
MANAGEMENT UNITS[2/] [3/]				
Early successional BLHW	0	+315	0	+315
Late successional BLHW	0	-310	0	300
Cypress-tupelo	0	-1	0	-1
Open land	0	+20	0	+20
Bayou	0	-10	0	-10
Headwater Lake	0	-20	0	-20
RECREATION				
Early successional BLHW	0	-5	-5	-5
Late successional BLHW	0	-60	-60	-60
Cypress-tupelo	0	-5	-5	-5
Open land	0	+70	+70	+70

[1/] Bottomland hardwood.
[2/] 145 acres early successional BLHW to open to early successional BLHW.
[3/] Assumes that five units would be built although initial construction would involve only two pilot units.

TABLE 6-5

DIRECT CONSTRUCTION IMPACTS OF THE AVOCA ISLAND LEVEE[1/]

	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
Fresh Marsh	0	0	-1,455	0
Brackish Marsh	0	0	0	0
Delta	0	0	-2,910	0
Open Land	0	0	+2,180	0
Fresh Bayous	0	0	+2,180	0
Brackish Bayous		0		0

[1/] Assumes that all reaches would be built although initial construction would involve only the first reach. Additional reaches might never be built.

TABLE 6-6

SUMMARY OF DIRECT CONSTRUCTION IMPACTS[1/]

	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
Early Successional BLHW[2/]	-2,690	+1,040	+2,585	+2,940
Late Successional BLHW	-8,220	-9,360	-8,670	-9,190
Cypress-Tupelo	-2,390	-5,366	-5,705	-5,760
BLHW/CT MIX[3/]	-30	-30	-30	-30
Open Land	+1,270	+1,140	+3,980	+1,410
Fresh Marsh	0	-360	-2,545	-1,090
Brackish Marsh	0	0	0	0
Delta	0	0	-2,910	0
Riverine	0	+920	-90	+150
Fresh Bayous	+12,040	+12,090	+13,220	+11,530
Brackish Bayous	0	0	0	0
Headwater Lake	0	-20	0	-20
ES To Open To ES[4/]		2,695	2,960	2,875

1/ Assumes all reaches of the Avoca Island levee (Plan 7 only) and five management units would be built. Initial construction would involve building of only two management units and the first reach of the Avoca Island levee. Additional reaches of the levee might never be built.

2/ Bottomland hardwood.

3/ Bottomland hardwood/cypress-tupelo mix.

4/ Early successional bottomland hardwood to open to early successional bottomland hardwood.

TABLE 6-7

ACRES WITHIN THE PROJECT AFFECTED AREA
(1,000's)

Habitat type		2030			
	1980	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
Early successional BLHW[1/]	93.9	35.2	58.5	42.1	60.4
Late successional BLHW[2/]	332.0	186.1	339.3	177.7	339.5
Cypress-tupelo[2/]	451.0	415.0	408.2	364.1	407.7
Composition unknown	0.0	51.6	44.1	44.6	44.1
BLHW/Cypress-tupelo mix	8.4	20.2	44.2	44.6	44.2
Open land	97.2	283.8	100.1	326.5	100.3
Fresh marsh[3/]	321.3	243.1	242.8	238.5	242.1
Brackish marsh[3/]	89.0	64.4	64.4	63.2	64.4
Saline marsh[3/]	107.3	69.3	69.3	69.2	69.3
Delta[3/]	10.1	135.0	135.0	130.7	135.0
River and distributary	31.1	32.1	33.1	32.1	32.3
Fresh bayous and slow canals	38.0	50.9	51.0	52.1	50.4
Headwater lakes	18.2	1.9	2.2	1.8	2.2
Backwater lakes	42.0	34.0	38.3	33.4	38.3
Cropland lakes	0.03	4.1	.03	4.9	.03
Brackish bayous and canals	6.2	8.1	8.1	8.3	8.1
Saline bayous and canals	6.1	7.4	7.4	7.4	7.4
Fresh marsh ponds and lakes	87.6	141.6	141.6	142.4	141.6
Brackish marsh ponds and lakes	55.2	75.3	75.3	76.3	75.3
Saline marsh ponds and lakes	64.4	99.0	99.0	99.1	99.0
Fresh bays	200.0	75.1	75.1	79.4	75.1
Brackish bays	58.9	58.9	58.9	58.9	58.9
Saline bays	53.8	53.8	53.8	53.8	53.8
Shallow gulf	804.0	804.0	804.0	804.0	804.0
Late Successional BLHW[4/] (flooded in floodway)	128.0	66.8	75.0	57.3	75.2
Early successional BLHW[4,5/] (flooded in floodway)	73.3	35.7	40.3	30.1	40.3
Cypress-tupelo[4,6/] (flooded in floodway)	173.0	146.3	138.0	116.0	137.9

1/ Bottomland hardwood.

2/ Figures given do not include acreage changes which would be caused by disposal of dredged material associated with maintenance dredging of existing waterways. This activity would cause about 1,400 acres of cypress-tupelo and about 600 acres of late successional bottomland hardwood forest to convert to early successional bottomland hardwood forest during project life.

3/ Includes impacts of all reaches of the Avoca Island levee extension (Plan 7 only) for comparative purposes.

4/ These categories reflect the number of acres of forest that would be flooded on an annual basis. The decrease in acreage in the future reflects the lowering of the flowline in all plans and a conversion of forest to other habitat types in Plan 7.

5/ Includes composition unknown.

6/ Includes cypress-tupelo bottomland hardwood mix.

reality, some resource management problems could be created. For purposes of assessing environmental impacts of management units, an unbiased effort was made to determine both the positive and negative impacts that could arise due to construction of five units. These units were the ones which seemed to offer the best potential for ultimate implementation. These impacts will be discussed in detail as they relate to pertinent significant resources. It should be noted that only two pilot units are proposed for initial implementation. Should major modification of the management unit concept occur during subsequent detailed studies of the two pilot units, then construction and operation of others could be significantly different from the present concept. Therefore, actual impacts could differ significantly from those assessed in this report and a supplement to this EIS would have to be prepared.

6.4 A third data gap is the lack of adequate information about the effects of Avoca Island levee extensions upon the natural resources of the backwater area northeast of Morgan City and the Terrebonne Parish marshes. It was necessary to use preliminary hydraulic, water quality, and marsh loss data to project future conditions and to calculate mitigation needs. It was assumed that as the delta developed, it would naturally reduce the amount of sediment transported to the western Terrebonne Parish marshes. This reduction was not quantified. Because of these uncertainties, future projections based on subsequent studies of these areas could change significantly. In the NED plan, only the first reach of the levee extension is proposed. However, as a basis for comparison, the impact assessment which follows assumes that all reaches of the levee would ultimately be built. This in no way presupposes that extension of the Avoca Island levee for the full length is desirable. The final solution to the backwater flooding problem would result from studies to be made over the next several years.

6.4a A fourth data gap is lack of details about modification of existing minor features to pass the project flood. These should have few significant environmental impacts; however, if any significant impacts become apparent, an EIS Supplement would be prepared.

Significant Resources

EARLY SUCCESSIONAL STAGE BOTTOMLAND HARDWOOD FOREST

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.5 With this plan, existing early successional forest acreage would decrease in the future by about 35,000 acres so that by the year

2030, there would be an estimated 59,000 acres in the project-affected area. This would be about 23,000 more acres than under future without-project conditions. Much of the decrease would be due to the natural process of plant succession, which would cause about 25,000 acres to convert to the late successional bottomland hardwood type during the first decade of project life. (Project levee construction between 1972 and 1980 eliminated 1,600 acres of this habitat.) About 2,700 acres would be temporarily altered by direct construction impacts within and adjacent to the Lower Atchafalaya Basin Floodway between 1980 and 1990. These acres would be converted initially to open land but would soon revegetate with early successional species such as willow or cottonwood. Additionally, construction work would create about 2,600 new acres of this forest type through conversion of other forest or open water habitats to open land, which would rapidly revegetate with early successional species during the first decade of project life. Widening Wax Lake Outlet overbank area and sediment control measures would also increase acreage. Additional gains in acreage of early successional forest would occur due to formation of new accretion lands in open water areas. This accretion process would continue throughout project life.

6.6 During the second half of project life, early successional forest acreage would continue to change as accretion and plant succession created new forest stands or converted old stands into the mid-to-late successional type. By 2080, virtually all of the currently existing stands would no longer exist but would be replaced by new ones continually forming as the accretion process continued. It is probable that implementation of Plan 4 would insure that more acres of this forest type would exist in 2080 than under future without-project conditions, as the environmental easement feature of this plan would help prevent their being cleared.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.7 Repair of erosion along the main channel or near a distributary realinement could adversely affect a minor amount of early successional bottomland hardwoods. Policing of the real estate features would prevent unauthorized clearing of forest. There would be no impacts due to mitigation measures.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.8 With this plan, existing acreage of early successional forests would decrease in the future by about 52,000 acres. By the year 2030, there would be an estimated 42,000 acres remaining within the project-affected area. With this plan, there would be only about 7,000 future acres more than under future without-project conditions.

As with Plan 4, some of the decrease would be due to the process of plant succession. Also important in decreasing the acreage would be the conversion of forestland to agricultural land. (As with Plan 4, levee construction between 1972 and 1980 destroyed 1,600 acres.) Changes in acreage due to direct construction impacts would be similar to those of Plan 4 within the Lower Atchafalaya Basin Floodway, but additional impacts due to channel training of the Lower Atchafalaya River and Wax Lake Outlet would result in the conversion of about 1,500 acres of riverine habitat, cypress-tupelo swamp, and fresh marsh to this habitat type during the first decade of project life. Additional gains in acreage would occur due to formation of accretion land in open water areas.

6.9 As with Plan 4, plant succession and accretion would continue to change the acreage of early successional forest during the second half of project life. By 2080, there would, however, be less of this forest type than with Plan 4 in effect. The reason for this would be the process of land clearing for agricultural conversion, which would result in the elimination of a portion of this forest. It is probable that more of this forest would be cleared under Plan 7 conditions than under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.10 Impacts would be similar to those of Plan 4 but the only real estate features to be policed would be the recreational lands and nondevelopment flowage easements.

Plan 9 (R)

Major Impacts of Proposed Project Features

6.11 Under this plan, the existing acreage of early successional forests would decrease in the future slightly less than under Plan 4 and there would be about 25,000 more future acres than under future without-project conditions. Direct construction impacts would be very similar to those of Plan 4 with the addition of a 1,500-acre gain due to channel training south of Morgan City. As in both Plans 4 and 7, formation of accretion lands in open water areas would increase the overall acreage of this forest in the future.

6.12 The impacts of this plan in the second half of project life would be virtually the same as for Plan 4.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.13 These would be the same as for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.14 Approximately 3,000 acres of early successional bottomland hardwood forest has been dedicated to disposal of dredged material from existing project features. These areas are not used yearly. Disposal in Sixmile Lake covers 2,000 acres and occurs only once every 3 years. As the early successional forests are covered, most existing ground cover, understory, and trees are killed, but the area usually starts revegetating as soon as the ground is dry. In areas where disposal is annual, revegetation rarely gets past the herbaceous plant and willow saplings stage. In areas where dredging is less frequent, further succession would occur.

6.15 Erosion repair around culverts, control structures, and canals could cause minor disruption to some early successional communities.

6.16 Prolonged flooding, as would be caused by operation of the floodway system, would have an adverse impact on early successional forests each time it occurred. Most mature trees would probably be able to withstand flooding. Some trees along eroding edges of channels would be lost. Understory and ground cover would probably be killed or defoliated by floodwaters; however, within 1 to 2 months after the flood, regrowth should be only slightly below preflood levels (Noble and Murphy, 1975).

LATE SUCCESSIONAL STAGE BOTTOMLAND HARDWOOD FOREST

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.17 With this plan, existing acreage of this forest type would increase in the future by about 7,000 acres so that by the year 2030, there would be an estimated 339,000 acres. This represents an increase of about 153,000 acres above the projected future without-project conditions, due primarily to the environmental easement feature of this plan although some increases in acreages of this habitat type would occur due to succession of early successional bottomland hardwood stands to the late successional state. Construction impacts due primarily to implementation of sediment control measures, channel training of the Lower Atchafalaya River, and raising the east and west protection levees would destroy about 6,940 acres during the first decade of project life. (Levee construction from 1972 to 1980 has already destroyed about 2,400 acres.)

6.18 The management unit features of the plan could have varied impacts upon growth of bottomland hardwood species. As reported by

Broadfoot and Williston (1973), annual impoundment of water in the Mississippi Delta on bottomland hardwood species from December through June caused increased diameter growth in species such as cottonwood, sweetgum, and green ash. Rudolph and Hunter (1964) reported that increased flooding would increase mast production in oak trees. On the other hand, McQuilkin and Musbach (1977) reported that production of sound pin oak acorns did not vary significantly between flooded and nonflooded areas, and Hosner (1962) reported that overwinter flooding that extended into the growing season resulted in the destruction of the seeds of pumpkin ash, green ash, and boxelder when flooding extended until 4 June. Observations indicate that the existing water regime in certain areas of the Lower Atchafalaya Basin Floodway and backwater area may be having an inhibitive effect on hardwood regeneration, especially on the more desirable species, when viewed from a silvicultural standpoint. In some areas, only low-value species that break dormancy late, such as overcup oak and bitter pecan, are able to reproduce, and in other areas, only highly water tolerant species, such as swamp privet and water elm, appear to reproduce successfully. Construction of management units that would attempt to maintain the existing water regime could have significant adverse impacts on bottomland hardwood species when growth of these forests are compared to what would occur under future without-project conditions. Estimates derived using the average annual shifted hydrograph indicate that about 30,000 acres of these forests would be inundated until 15 June during an average year within the five management units most likely to be built, and about 14,000 acres until 15 July. Under future without-project conditions, these acreage figures would be lower. (It should be noted, however, that under future without-project conditions, these forests might not in fact exist as the areas they occupy might be cleared for agricultural conversion.) Also, it should be pointed out that by maintaining the existing water regime, potential growth of ground cover and understory vegetation would be inhibited. This would significantly decrease the value of this habitat for terrestrial wildlife, such as deer. On the other hand, building of management units would slightly increase the peak of the annual hydrograph in some areas, at least during the first decades of project life, thus flooding for a 2- to 3-week period, areas that would not have been flooded in the absence of the management unit. This short period of flooding could benefit timber growth during most years. Due to the uncertainty associated with evaluating the impacts of management units on bottomland hardwood forests, a feature of Plan 4 would be to study carefully the impacts of the two pilot units on timber growth before building remaining units. Should problems be discovered, adjustments could then be made to correct them before additional units are built.

6.19 During the second half of project life, the total acreage of late successional bottomland hardwood forest would increase as early successional stages changed to more mature late successional stages. Species composition of the forest would also tend to change with time

so that by 2080, the proportion of less water tolerant species, such as sweetgum and oak, would increase in the northeastern parts of the project-affected area. Corresponding increases in the extent of ground cover plants would also occur.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.20 Erosion repair along the main channel or at distributary realinements might destroy a small amount of this habitat type. Policing of easements would preserve forest. No impacts due to mitigation measures would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.21 With this plan, a 154,000-acre reduction in the existing acreage of forest could occur so that by 2030, about 178,000 acres would remain within the project-affected area. Most of this decrease would be due to land clearing for agricultural conversion, both within the floodway system and in the backwater area northeast of Morgan City. Construction impacts would add to the decrease, with about 6,400 acres being destroyed during the first decade of project life, primarily due to sediment control, channel training, and raising the east and west protection levees. (Levee construction between 1972 and 1980 destroyed about 2,400 acres.) This decrease is about 8,000 acres more than would occur under future without-project conditions and would be due to additional land clearing caused by the lowered water levels brought about with Plan 7. Changes in forest species composition would be similar to those discussed for Plan 4.

6.22 During the second half of project life, additional decreases in forest acreage would occur due to further land clearing. The exact magnitude of this activity cannot be projected with certainty but it is probable that most of the land that would be dry enough to clear in the year 2030, but which would not have been cleared at that time, would be cleared before 2080. Most clearing would occur in the bottomland hardwood habitat type. Thus, as much as about 20,000 additional acres, and possibly more, could be cleared by 2080. The amount of land that would be cleared during the second half of project life with Plan 7 in effect would be about the same as under future without-project conditions. (These land clearing projections are based on a worst-case analysis. Actual rates of clearing could be lower if legal controls, such as the Section 404 permitting program, continue in the future.)

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.23 Impacts would be similar to those of Plan 4 except that the only real estate features which would be policed would be 1,500 acres of recreational land and the nondevelopment and flowage easements. The mitigation features of this plan would preserve about 16,800 acres which would otherwise be cleared for agricultural conversion.

Plan 9 (R)

6.24 The impacts of this plan would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.25 Maintenance dredging of existing project features has destroyed approximately 600 acres of this habitat type by disposal of dredged material. Since this disposal would be necessary only every 5 to 10 years, the areas would revegetate with early successional species between uses.

6.26 Operation of the floodway system would be expected to have a minor adverse impact on this habitat type. Some trees would be destroyed by heavy sedimentation or flooding, but the beneficial impact of nutrients carried into bottomland areas would probably outweigh this. As discussed under the early successional habitat type, ground cover and understory would be temporarily destroyed but would recover fairly quickly. During 1973, studies showed that approximately 707,400 acres of wooded land of all habitat types were flooded in the floodway system (US Army Corps of Engineers, 1974).

CYPRESS-TUPELO SWAMP

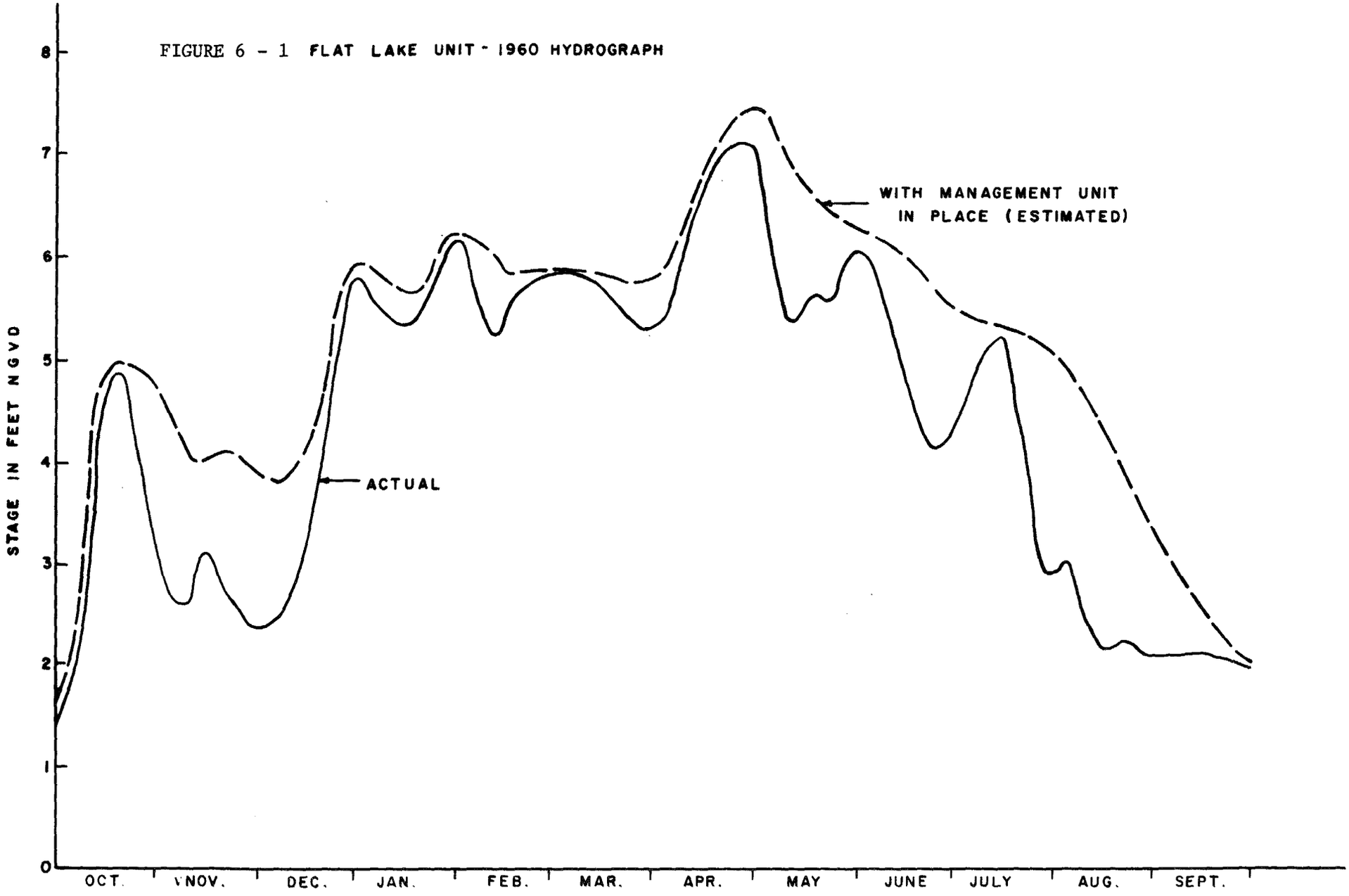
Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.27 With this plan, existing acreage of this type would decrease in the future by about 43,000 acres so that by the year 2030, there would be an estimated 408,000 acres in the project-affected area. This represents a decrease of about 7,000 acres more than would occur under future without-project conditions. It should be noted, however, that this plan would not prevent most of the cypress-tupelo forests in the backwater area northeast of Morgan City from becoming subjected to increased depth and duration of flooding. This flooding could have an inhibitory effect on tree growth and reproduction. A major cause of acreage decrease in this habitat type would be plant succession

occurring in response to falling water levels within the floodway as the Atchfalaya River matures. As swamps located at higher elevations become drier, they would be invaded by bottomland hardwood species and would convert to the early successional bottomland hardwood mixed with cypress-tupelo habitat type. This category could increase by about 36,000 acres by 2030. Construction impacts during the first decade of project life would also decrease the total acreage by about 3,860 acres. (Levee construction between 1972 and 1980 destroyed about 1,500 acres.) About half of these construction impacts would be due to conversion of cypress-tupelo areas to borrow pits as a result of raising the east and west protection levees and about half to channel training of the Lower Atchafalaya River. An additional impact of Plan 4 on cypress-tupelo swamps would be the preservation of about 20,000 acres within the lower floodway in its existing seminatural state due to acquisition of an environmental easement which prevents timber harvesting. Under future without-project conditions, it is estimated that half of the cypress-tupelo forests would be logged by 2030 (this is a worst-case estimate). Thus, Plan 4 with its easement could preserve 10,000 acres of cypress-tupelo forests that might be logged under future without-project conditions. Plan 4 would recommend implementation of two pilot management units and based upon their operational success, possible future implementation of other units. At the present time, the possible impacts of management units upon timber resources are not fully understood. Within the five areas of highest potential for development as management units, there are currently about 43,000 acres of cypress-tupelo forests. It is possible that management units could affect these cypress-tupelo forests in either a positive or negative way. Management units would be designed to attempt to maintain, as nearly as possible, the current water regime in the areas. Therefore, water levels in the future would not decline as much as would be the case if no management units were in place. This would insure that the existing acreage of "pure stand" cypress-tupelo forest remains rather than being converted, in part, to the category of bottomland hardwoods mixed with cypress-tupelo. It will not be possible, however, to exactly mimic the existing water regimes and hydrologic conditions in the future. To maintain water levels in the future that approximate those present today, it would be necessary to restrict the natural outlets by construction of weirs and, in some cases, low level levees (see Plate 11). Proposed plans also call for construction of new inlets and for closure of certain bayous and canals that now convey water into the areas (see Plate 11). The effect of all these features would be to reduce, by as much as one-half, the net amount of water flowing into and through the management unit during an average water year, while at the same time maintaining water levels that approximate existing conditions (the peaks of the average hydrographs for some units would actually be slightly higher than at present, at least during the first decades of project life). Management units would also reduce the degree of short-term water level fluctuation that occurs within each area (see Figure 6-1). This reduction in water

FIGURE 6 - 1 FLAT LAKE UNIT - 1960 HYDROGRAPH



level fluctuation along with reduced flows through the units could result in reduced current velocities. It is possible that these altered conditions could have deleterious effects upon timber growth, reproduction, and total net primary productivity of the swamp forest. For example, Hook et al. (1970) reported that tupelo trees seldom, if ever, reach saw-log size in ponds and oxbow swamps having stagnant water, and Harms (1973) reported that tupelo seedlings grew more rapidly in a moving water regime. Hook et al. (1973) also reported that tupelo grew best under a fluctuating water regime where the water table alternated from 9 or 18 inches below the surface to 8 inches above the surface. Further, Schlesinger, as cited by Conner and Day (1976), reported that the Okefenokee swamp in Georgia is unproductive, presumably because of the very slow movement of the water. Therefore, much of the available evidence indicates that growth of trees such as tupelo is correlated with the degree of water level fluctuation and current velocity of a given site. Management units could decrease both current velocity and degree of water level fluctuation more than would be the case under future without-project conditions, and could, therefore, adversely affect the growth of trees such as tupelo. A feature of Plan 4 that might offset some of the potential problems that could arise due to reduced flow through in the management units is the provision for improvement of circulation within each unit by creating openings in dredged-material embankments (spoil banks), which presently impede water movement. Plan 4 includes provisions for evaluating the effects of the two pilot management units on timber resources, and if the problems mentioned above occur, corrective steps could be taken in building future units to eliminate them.

6.28 Another feature of Plan 4 that might adversely affect cypress-tupelo forests in the Lower Atchafalaya Basin Floodway is the state-proposed forestry management plan (see Appendix B), which calls for restricting cutting to maintain or increase the ratio of cypress to tupelo. Certain sites within the lower floodway are better suited to the growth of tupelo than to cypress. To favor cypress on these sites could decrease the overall biological productivity of the area although it would increase timber production as little market presently exists for tupelo.

6.29 During the second half of project life, total acreage of cypress-tupelo swamps would probably tend to stabilize at a level near that existing in 2030. However, continued logging could result in an increase in the amount of cut-over swampland. Also, the unfavorable water regime of the lower floodway and backwater area might make it difficult for these areas to regenerate as true cypress-tupelo swamp similar to that existing today. These conditions would not differ greatly, however, from what would occur under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.30 Policing of the real estate easements would prevent unauthorized clearing of this habitat type.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.31 With this plan, existing acreage of cypress-tupelo forests would decrease in the future by about 87,000 acres so that by 2030, there would be about 364,000 acres in the project-affected area. This represents a decrease of about 51,000 acres more than would occur under future without-project conditions. Much of this decrease would be due to land clearing in the backwater area northeast of Morgan City and to plant succession within the Atchafalaya Basin Floodway system, which would convert some of the swamp areas at higher elevations into forests of cypress-tupelo mixed with bottomland hardwood species. Additionally, some areas of this habitat type within the floodway would be cleared for agriculture, and construction impacts during the first decade of project life would decrease the total acreage by about 4,200 acres. (Levee construction from 1972 to 1980 destroyed about 1,500 acres.) Timber harvesting effects would be similar to those of Plan 4, except that no planned preservation of uncut tracts would occur. Management units are not a part of this plan and would not affect the forest (except in Buffalo Cove where mitigation measures would be implemented).

6.32 During the second half of project life, the acreage of cypress-tupelo forests would probably continue to decrease as additional areas were cleared for agricultural use when lands became sufficiently dry as a result of continued lowering of water levels within the floodway. These impacts would probably be greater with Plan 7 than under future without-project conditions. Continued timber harvest would also occur and would have much the same effect as under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.33 There would be no significant impacts due to operation and maintenance. Creation of the Buffalo Cove management unit as a mitigation measure could help prevent the invasion of much of the existing cypress-tupelo swamp in that area with willow due to the lowered water levels that would occur if no management unit were built. Some detrimental impacts on growth of existing cypress and tupelo in the Buffalo Cove area could result from the reduced flow through and water level fluctuation brought about by construction of the management unit. Freshwater diversion into swamplands south of

Donaldsonville, Louisiana, as a mitigation measure should increase the productivity of that area.

Plan 9 (R)

6.34 Impacts to cypress-tupelo forests with this plan would be somewhat similar to those of Plan 4. However, a slight increase in acreage eliminated due to construction impacts caused by channel training of the Lower Atchafalaya River and Wax Lake Outlet and due to work at the outlets would occur. This additional work would eliminate about 260 acres. Also, this plan would not guarantee the preservation of about 20,000 acres of these forests in their existing semi-natural state. The real estate provisions of this plan would allow timber harvest throughout most of the lower floodway. Since hydrologic conditions in parts of this area are not conducive to regeneration of cypress, these areas, if logged, might never regenerate as a true cypress-tupelo forest.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.35 Maintenance dredging has destroyed approximately 1,400 acres of this habitat type. Approximately 900 acres along the east freshwater distribution channel is used every 5 years. Initial disposal destroyed the existing trees and raised the elevation of the area. Revegetation was with early successional species which would be destroyed with subsequent disposals. Nearly 400 acres near the Bayou Sorrel lock would be used annually and would probably never pass beyond a herbaceous plant-young willow stage.

6.36 Operation of the floodway system would adversely impact this habitat type by bringing large amounts of sediment into swamps. After the waters receded, early successional species would invade the newly emergent land. It is impossible to estimate the acreage that would be affected, although it could be quite large.

AGRICULTURAL LANDS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.37 With this plan, there would be no significant increase in the amount of agricultural land in the future. Although total agricultural acreage would not increase in the future under Plan 4, there would be a highly significant decrease in such lands when compared to what would occur under future without-project conditions. This decrease would amount to about 184,000 acres of open land and would be

due primarily to the environmental easement feature of Plan 4, which would prevent land clearing within the Lower Atchafalaya Basin Floodway. Construction impacts would also eliminate a small amount of land. It should be noted that some of the land that would be affected by the land clearing prohibition of Plan 4 is classified as potential prime farmland (Plates 20 through 22). Moreover, this plan would not provide flood protection to about 10,000 acres of existing prime and unique farmland, used primarily for sugarcane production, in the backwater area northeast of Morgan City. Future rising water levels could render this land unusable for agriculture although projects such as the Terrebonne Parish Forced Drainage Project would provide protection to about 3,000 acres of the land. Within the lower floodway, the restriction on row-crop agriculture would insure that pesticide pollution, due to agricultural runoff, would not affect thousands of existing acres of potential unique farmland in the area that could be suitable for commercial crawfish production (Plates 20 through 22).

6.38 With this plan, total net income due to agricultural activity would rise from about $522,000 at the beginning of project life to about $3,028,000 by 2030. Much of this increase would be due to conversion of agricultural activity in the backwater area northeast of Morgan City from production of sugarcane to production of soybeans. The environmental easement feature of Plan 4 would prevent further agricultural expansion in the lower floodway and because of this, Plan 4 would actually cause a net project loss of about $6,317,000 in annual net income by the year 2030, when compared to future without-project conditions.

6.39 During the second half of project life there should be no further increase in farmland acreage while under future without-project conditions, there would be a highly significant increase due to the continued land clearing that would take place in the post-2030 period within the Lower Atchafalaya Basin Floodway. The difference would amount to about 25,000 acres of open land, most of which would be agricultural.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.40 Operation and maintenance of proposed features would have a significant negative impact on agricultural lands within the Wax Lake Outlet overbank area, which is presently protected by ring levees. This land would be subjected to increased flooding following widening of the overbank area.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.41 With Plan 7, there would be a dramatic increase in the amount of agricultural land in the future. Open land, which is primarily agricultural, would increase by about 229,000 acres by 2030. This represents a 43,000-acre increase over what would occur under future without-project conditions. This increase over present conditions would occur due to land clearing in the backwater area northeast of Morgan City and in the lower floodway. Construction impacts would eliminate only a small amount of this land. Much of the land cleared north of I-10 would be prime farmland, and most of that cleared in the backwater area would be both prime and unique farmland. This plan would have beneficial impacts upon the presently existing unique farmlands of the backwater area due to the lessened flood hazard it would create, but it would have an adverse impact upon the potential unique farmlands in the lower floodway that could be commercially farmed for crawfish. This would occur because of the increased water pollution that would follow expansion of row-crop agriculture on the higher lands surrounding the swamplands, where crawfish could be raised commercially.

6.42 With this plan, total net income due to agricultural activity would rise from about $1,522,000 at the beginning of project life to about $11,297,000 by 2030. About one-third of this increase would be due to agricultural expansion in the backwater area northeast of Morgan City and two-thirds due to similar expansion in the lower floodway. These increases would represent a net project gain of about $1,952,000 by the year 2030 compared to future without-project conditions.

6.43 During the second half of project life, there would be continued expansion of agricultural land in the lower floodway. By 2080, there would be about the same amount of agricultural land as would occur under future without-project conditions. As the acreage continued to expand, the adverse impacts discussed previously on the potential unique farmlands of the lower basin, where crawfish could be grown commercially, would become more severe.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.44 Operation and maintenance impacts would be the same as for Plan 4. The purchase of 16,800 acres of bottomland hardwood forest and the building of the Buffalo Cove management unit for mitigation purposes would both reduce the overall future acreage of agricultural land within the project-affected area.

Plan 9 (R)

6.45 The impacts of this plan would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.46 Maintenance of existing features would have no impact on agricultural land.

6.47 Operation of the floodway system would adversely impact agricultural lands. The following discussion of flooding impacts of the 1973 flood (US Army Corps of Engineers, 1974) will indicate the types of impacts that could occur with future uses. During 1973, approximately 24,300 acres of agricultural lands within the floodways were flooded. An accurate estimate of the impacts assignable to operation of the floodway is complicated by the existing US Army Corps of Engineers flowage easement program. Owners retained virtually all rights to development that do not interfere with the use of the area as a floodway. Most of the agricultural lands are cropped on a yearly basis. Thus, crops lost during operation of the system have, in a sense, already been charged to the cost of the project and are more accurately described as losses of speculative investment. Holding this concept in mind, the following are the agricultural losses which were estimated to have resulted from the 1973 flood: crop, $2,021,000; pasture, $164,000; livestock, $673,000; and other, $101,000. The most significant agricultural losses were sustained by the soybean crop located mainly in Pointe Coupee Parish, and by livestock. Many cattle were lost because not all were evacuated in time to prevent drowning. Evacuation costs, forced sales at reduced prices, and extra feed costs all contributed to livestock losses.

6.48 It is likely that losses similar to those that occurred in 1973 would occur with future uses of the Morganza Floodway. If the West Atchafalaya Floodway were to be utilized, damages would be even greater because agricultural development there is more intense. However, frequency of use of the West Atchafalaya Floodway is estimated to be less than once in 100 years. These losses would be similar for all plans in the near future, but losses in the more distant future would be much greater if Plan 7 were implemented. This would occur because this plan would not prevent future agricultural development in the Lower Atchafalaya Basin Floodway.

FRESH MARSH

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.49 With this plan, there would be an estimated future reduction of fresh marsh of about 78,500 acres so that by 2030, about 243,000 acres would exist within the project-affected area. This reduction would represent a loss of approximately 300 acres more than that which might occur under future without-project conditions. Direct construction impacts of levee improvement west of Berwick and widening the Wax Lake Outlet overbank would account for most of this loss. (Levee raising from 1972 to 1980 destroyed about 100 acres of fresh marsh.)

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.50 Operation and maintenance would have no impact on fresh marsh.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.51 With this plan, there would be an estimated reduction in acreage of fresh marsh of about 82,800 acres so that by 2030, nearly 238,500 acres might exist within the project-affected area. This would be a loss of about 4,600 acres above that which would occur under future without-project conditions. The primary cause of this reduction would be increased marsh deterioration in the Terrebonne Parish area that might occur due to construction of the Avoca Island levee extension. The levee extension would markedly reduce river overflow into the fresh marshes and, thus, would reduce the input of sediment and nutrient-laden waters that nourish the marsh. The amount of sediment reduction is unknown, but a preliminary approximation has been made. (See Appendix G for a rationale for calculating marsh loss). Based upon this preliminary data, if only Reach 1 were built, the loss would be nearly 200 acres, while if the entire extension were constructed, nearly 2,100 acres could be lost. Direct construction impacts of other project features would destroy about 1,100 acres. If the first reach of the Avoca Island levee were built, an additional 700 acres would be destroyed due to direct construction and if the entire extension became a reality, nearly 1,500 additional acres would be lost due to construction. Construction of channel training works would decrease sediment and nutrient input into adjacent fresh marshes and increase their rate of deterioration. (Levee construction between 1972 and 1980 destroyed about 100 acres of marsh.) There is evidence that the reduction in stages of approximately 1 foot during a normal water year that would occur following extension of the levee would

have some beneficial effects on fresh marshes by converting them to a drier type with increased plant diversity. Moreover, there is evidence that a large amount of marsh in this area deteriorated following prolonged flooding during the floods of 1973, 1974, and 1975 (US Fish and Wildlife Service, 1981). Stabilization of water levels by the levee could help counteract this trend should it occur again. The secondary impacts of the Avoca Island levee extension are difficult to predict due to the complexity of the estuarine system and lack of data. Due to this lack of data numerous studies would have to be conducted prior to construction of Reach 2 of the levee. These studies would determine impacts and clarify mitigation needs. Table 6-8 describes some proposed studies.

TABLE 6-8

TYPES OF STUDIES WHICH MIGHT BE CONDUCTED TO DETERMINE IMPACTS AND MITIGATION MEASURES ASSOCIATED WITH AVOCA ISLAND LEVEE EXTENSION

1.	Determine present and future rates of river-borne sediment deposition and patterns of distribution in Terrebonne Parish wetlands.
2.	Determine water circulation patterns in the Terrebonne Parish wetlands.
3.	Identify factors responsible for marsh loss and quantify the degree to which each factor contributes to the loss.
4.	Determine the volume of freshwater necessary to maintain the existing and future without-project salinity regime over project life.
5.	Develop a technique for conveying sediment-rich river water across the Avoca Island Cutoff Channel into the Terrebonne Parish marshes.
6.	Determine and quantify the adverse and beneficial impacts on biological resources due to the higher stages which would occur in the Terrebonne marshes and in the backwater area northeast of Morgan City under future without-project conditions.
7.	Determine the magnitude of subsidence in the Terrebonne Parish marshes and the backwater area northeast of Morgan City and what effects it may be having on existing biological communities.

6.52 During the second half of project life, marsh deterioration in Terrebonne Parish would probably continue due to reduction in sediments caused by the Avoca Island levee and natural causes.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.53 Operation and maintenance would have no impacts. Water diversion structures built for mitigation would offset project-induced losses to marsh productivity.

Plan 9 (R)

6.54 Most impacts of this plan would be identical to those of Plan 4, except an additional 700 acres of marsh would be lost to construction impacts associated with channel training works along the Lower Atchafalaya River and Wax Lake Outlet. These works would also increase marsh deterioration by decreasing sediment and nutrient input.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.55 Maintenance of existing features would have no impact on fresh marsh. Operation of the floodway system would generally have a net beneficial impact on fresh marsh. The nutrients and sediments carried by the floodwaters would enrich the marsh and replenish subsiding areas. However, if flooding were excessively prolonged and deep, it would be possible that marsh plants could be killed and erosion could occur. This is apparently what happened in the project area during the high water periods of 1973, 1974, and 1975.

BRACKISH MARSH

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.56 With this plan, existing brackish marsh would decrease by about 24,600 acres by the year 2030 due to natural marsh deterioration. This same decrease would occur under future without-project conditions.

6.57 During the second half of project life marsh deterioration would continue.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.58 Operation and maintenance of proposed features would have no impact on brackish marsh.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.59 Brackish marsh could decrease by 25,800 acres by 2030, compared to existing conditions. This would be a decrease of 1,200 acres over future without-project conditions. This loss would be due to construction of Reaches 3 to 5 of the channel alinement of the Avoca Island levee, which could decrease sediment and nutrient transport to brackish marshes and thereby increase the land loss rate. If only Reach 1 were built, no impacts would occur due to the levee extension.

6.60 During the second half of project life marsh deterioration would continue.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.61 Operation and maintenance of proposed project features would have no impact on brackish marshes. The water diversion structure built for mitigation would offset project-induced losses to marsh productivity.

Plan 9 (R)

6.62 Impacts would be similar to those described for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.63 Maintenance would have no impact on brackish marsh.

6.64 Operation of the floodway system would probably have an overall beneficial impact on brackish marshes because the floodwaters would enrich the marsh with sediments and nutrients. However, prolonged flooding could kill marsh plants and increase erosion.

SALINE MARSH

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.65 With Plan 4, there would be approximately 69,300 acres of saline marsh in the project-affected area by 2030. This represents a decrease of nearly 38,000 acres from the present and is the same amount as would occur under future without-project conditions. The majority of this decrease would occur as the saline marsh deteriorates.

6.66 During the second half of project life, marsh deterioration would continue as erosion and subsidence persisted.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.67 Operation and maintenance would have no impact upon saline marsh.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.68 The loss of saline marsh with this plan would be slightly greater than with any other plan. By 2030, there would be 38,100 fewer acres than exist at present. Compared to future without-project conditions, Plan 7 could cause a loss of about 100 acres as a result of possible indirect impacts of construction of Reach 3 of the Avoca Island levee in 2003. This reach would slightly reduce river sediment and nutrient flows to the saline marshes. Construction of only Reach 1 would have no impact on saline marsh due to the levee extension.

6.69 During the second half of project life, marsh deterioration would continue.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.70 Operation and maintenance would have no impact on saline marsh. The freshwater diversion structure proposed for mitigation would offset marsh productivity losses caused by this plan.

Plan 9 (R)

6.71 Impacts would be similar to those described for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.72 Maintenance of existing features would have no impact on saline marsh.

6.73 Operation of the floodway would have a net beneficial impact on saline marshes by nourishing them with nutrients and sediments. Extensively prolonged flooding might kill plants and increase erosion.

ATCHAFALAYA DELTA

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.74 With this plan, the development of the delta in Atchafalaya Bay would be a major occurrence in the project-affected area. Delta growth is difficult to predict, but it is possible that with Plan 4 and under future without-project conditions the delta would increase from the present 10,100 acres to approximately 135,000 acres by 2030. Since Louisiana appears to be losing 39 square miles of marsh a year (Wicker et al., 1980), this plan (and Plan 9) offers the best chance to preserve the newly developing delta. These plans might allow the creation of an average of 4 square miles of land per year, continuing for at least 50 years.

6.75 During the second half of project life, the delta would probably continue to grow in elevation and aerial extent and become more densely vegetated with additional species of plants. By 2030, delta would be developing in the open gulf at an unquantifiable rate. Growth in this water, 10 to 20 feet deep, would be slower than in the more shallow Atchafalaya Bay.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.76 There would be no impacts due to mitigation measures. Operation of the widened Wax Lake Outlet overbank area would increase delta formation in the western part of Atchafalaya Bay.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.77 This plan would have an adverse impact on delta development in Atchafalaya Bay due to the channel alinement of the Avoca Island levee. If Plan 7 were implemented by 2030, there might be 4,300 fewer

acres of delta than under future without-project conditions. Direct construction impacts, if the entire Avoca Island levee extension were built, would cause a loss of 2,900 acres. Reach 3, to be built by 2003, would block the eastern distributary of the first major bifurcation of the delta channel. This channel would be responsible for the sediment transport that would have built and nourished the delta east of the channel. Blockage of this channel, combined with the high rate of subsidence and compaction, might cause increased deterioration of the isolated portion of the delta. Possible construction of Reaches 4 and 5 might similarly impact the eastern isolated portion of the delta. The net result of this levee construction might be the deterioration of 4,300 acres of newly developed delta. Thus, this plan would allow the creation of only an average of 3.4 square miles of new delta per year for 50 years. If only Reach 1 were built, no impacts to delta would be caused by the levee extension.

6.78 During the 2030-2080 period, the western delta would probably continue to grow, but the eastern area cut off by the levee would show an increasing deterioration rate and approximately 17,000 acres would become open water.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.79 Impacts would be the same as described for Plan 4.

Plan 9 (R)

6.80 Impacts would be the same as described for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.81 The removal of 1,228,500 cubic yards of dredged material each year from the Atchafalaya Basin and disposal of this on land would remove a small amount of the total sediment available for delta building. It is impossible to calculate the loss of delta that would be due to this maintenance dredging, but it would probably be minor.

6.82 Floodflows passing through the floodway system would have a significant beneficial impact on the delta. In 2 months, the flood of 1973 produced several hundred acres of land in Atchafalaya Bay. Not only would sediment-rich waters from the Mississippi River be diverted into the floodway, but the floodwaters would erode channel banks and the next operation of the floodway would be expected to dramatically increase the amount of deltaic land. Future use of the floodway would be expected to increase the percentage of sediment diverted to Atchafalaya Bay since the existing mainstem lakes are nearly filled with sediment.

RIVER, MAJOR DISTRIBUTARY, AND MAIN STREAM LAKES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.83 With this plan, there would be a gain of 2,000 acres of habitat by 2030. Under future without-project conditions there would be a 1,000-acre gain from the present acreage. This 1,000-acre gain would be due to bank erosion. In reality, the amount of riverine habitat would increase as the delta builds; however, this increase due to delta development has been included in the delta habitat type. Approximately 900 acres of the 2,000-acre increase in Plan 4 would be due to construction impacts of bank stabilization, changes at the outlets and sediment control. The volume of riverine habitat would be increased by channel training, but it would be difficult to quantify the amount of increase.

6.84 During the second half of project life, the acreage of this habitat type would probably continue to increase due to erosion.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.85 Repair of main channel crevassing would prevent the river from taking another course. No impacts due to mitigation measures would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.86 Riverine habitat would increase by 1,000 acres with this plan. Direct construction impacts of channel training in the Lower Atchafalaya River would decrease the amount of riverine waters, and channel stabilization and sediment control would offset this increase. The 1,000-acre increase would be due to erosion.

6.87 Acreage would probably continue to increase during the 2030-2080 period.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.88 Impacts would be as described for Plan 4.

Plan 9 (R)

Major Impacts of Proposed Project Features

6.89 Riverine habitat would increase by 1,200 acres with Plan 9. Direct construction losses due to channel training in the Lower Atchafalaya River would be more than offset by construction gains due to changes at the outlets and sediment control. The bulk of the gains would be due to erosion.

6.90 During the second half of project life, riverine habitat would probably increase slightly.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.91 Impacts would be as described for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.92 Maintenance of the low sill structure and outflow channel at Old River prevents capture of the Mississippi River by the Atchafalaya River. Maintenance dredging in the main channel from Old River to Morgan City removes sediment in the river. Maintenance dredging of the east and west access channel and the east freshwater distribution channel maintains these habitats.

6.93 Operation of the floodway system would increase the volume of riverine habitat by scouring the channel deeper. The surface area would probably increase slightly since deposition of sand bars would probably not equal erosion. The acreage of mainstem lakes would be decreased with each usage of the floodway until at some period, the lakes would no longer exist.

FRESH BAYOUS, CANALS, AND BORROW PITS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.94 Plan 4 would increase the amount of bayou, canal, and borrow pit habitat in the project-affected area from 38,000 acres in 1980 to 51,000 acres in 2030. (Construction of borrow pits between 1972 and 1980 increased this habitat type by 4,410 acres due to raising of various levees.) Between 1980 and 2030, this habitat type would increase by an additional 7,220 acres because of raising various levees; 60 acres because of channel training in the Atchafalaya River;

110 acres because of construction at the outlets; and 290 acres because of widening the Wax Lake Outlet overbank. Thus, the total direct construction impacts would cause an increase of 12,090 acres. Compared to future without-project conditions, this plan would cause an increase of 100 acres due to construction impacts. Sediment control features would help to keep existing bayous slightly deeper than they would be under future without-project conditions and the management unit feature would prevent draining of some bayous during low water.

6.95 During the second half of project life, it is probable that an unquantifiable acreage of bayous within the basin would fill due to sedimentation, but the acreage would be less than under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.96 Mitigation measures and operation and maintenance of proposed project features would have no impact on this habitat type.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.97 As described for Plan 4, prior construction has increased borrow habitat by 4,410 acres. By 2030, there would be 14,100 more acres in the project-affected area than there are at present. Between 1980 and 2030, the following acreage gains would occur due to construction of borrow pits for the following features: levees, 6,170; channel training in the Atchafalaya River, 60; outlet construction, 110; widening of Wax Lake Outlet overbank, 290; and the Avoca Island levee extension, 2,180. These direct construction impacts would total 13,220 acres. Compared to future without-project conditions, this plan would cause an increase of 1,180 acres due mostly to construction of the Avoca Island levee extension. Sediment control would help to keep existing bayous deeper than under future without-project conditions.

6.98 Impacts between 2030 and 2080 would be similar to those described for Plan 4.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.99 No impacts would occur due to operation and maintenance.

6.100 Building Buffalo Cove management unit and the purchase of 16,800 acres of bottomland hardwood forest as mitigation measures would benefit some fresh bayous by helping maintain them in a more natural state than would otherwise be the case.

Plan 9 (R)

Major Impacts of Proposed Project Features

6.101 By 2030, there would be an additional 12,400 acres of this habitat in the project-affected area. Prior to 1980, there were 4,410 acres of borrow created. During the 1980-2030 period, gains in borrow pits would occur due to construction of the following: levees, 6,660 acres; channel training of the Atchafalaya River, 60 acres; widening Wax Lake Outlet overbank, 290 acres. Thus, the total direct construction impacts would include a gain of 11,530 acres of borrow pits. Compared to future without-project conditions, this plan would decrease borrow pit acreage by 500 acres because the lowered flowline would allow lower levees.

6.102 During the second half of project life, impacts would be similar to those described for Plan 4.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.103 No impacts would occur.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.104 Removal of debris and shoaling material from existing drainage canals would keep flows fairly constant and prevent clogging.

6.105 Operation of the floodway system would have a minor impact on this habitat type. Some waterways would be scoured deeper and eroded by floodwaters while others would become more shallow after the flood due to sediment deposition.

HEADWATER LAKES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.106 With this plan, there would be a loss of 16,000 acres of headwater lakes by 2030 because these lakes would become filled with sediment and water levels in the floodway would fall. These changes would occur despite the inclusion of sediment control and management units in this plan. For purposes of impact assessment, it was assumed by the Agency Management Group that management units would preserve present water levels. If present levels are compared to those that would occur under future without-project conditions, it can be seen

(Table 6-9) that levels would drop 1 to 1.5 feet without units. If present levels were maintained, units would preserve approximately 40 acres of headwater lakes as water levels fall. However, US Army Corps of Engineers data indicate that management units could not maintain present water levels until 2030. Management units would prevent draining of lakes at low water. Compared to future without-project conditions, the environmental easements of Plan 4 would prevent 160 acres of lakes from becoming classified as cropland lakes. Sediment control would help in preservation of headwater lakes by keeping the remaining lakes deeper.

TABLE 6-9

PEAKS OF AVERAGE ANNUAL SHIFTED STAGE HYDROGRAPHS

Management Unit	1980 Level (feet NGVD)	Future Without-Project Conditions (Estimated 2030 Level Without Management Unit) (feet NGVD)
Henderson	18.1	16.3
Cocodrie Swamp	15.8	14.1
Beau Bayou	14.6	13.1
Buffalo Cove	13.0	12.1
Flat Lake	9.1	8.0

6.107 By 2080, it is probable that the 2,200 acres of headwater lakes existing in 2030 would be almost eliminated due to sedimentation. Some lakes would remain, but it is difficult to estimate the acreage.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.108 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.109 With Plan 7, there would be only 1,800 acres of headwater lakes in the basin by 2030, a loss of 16,400 acres. The majority of this loss would be caused by sedimentation and lowering of water levels. The extensive clearing of forests that this plan allows would cause many acres of headwater lakes to be classified as cropland lakes by 2030.

6.110 Compared to future without-project conditions, there would be 100 fewer acres of headwater lakes by 2030. This reduction would be due to sedimentation and conversion of headwater lake habitat to cropland lake habitat, since Plan 7 allows more clearing than would occur under future without-project conditions.

6.111 Impacts during the second half of project life would be similar to those described for Plan 4.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.112 No impacts due to operation and maintenance would occur. Purchase of 16,800 acres of bottomland hardwood forest for mitigation purposes could benefit some headwater lakes by helping to maintain them in a more natural state than would otherwise be the case.

Plan 9 (R)

6.113 Impacts would be similar to those described for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.114 Maintenance of existing features would have no impact on headwater lakes.

6.115 Operation of the floodway system would hasten sedimentation in headwater lakes. Most sediment enters these lakes during flood events. All rooted aquatic plants would probably be smothered by the blanket of sediment.

BACKWATER LAKES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.116 With this plan, there would be a reduction of 3,700 acres in backwater lakes by 2030. This entire loss would be in the Lower Atchafalaya Basin Floodway and would occur because these lakes would become filled with sediment and water levels would drop. The inclusion of management units and sediment control in this plan would slow these processes but not halt them. It is estimated that management units would prevent the loss of approximately 1,100 acres of backwater lakes due to falling water levels. Sediment control would prevent the filling of additional acres and would keep water deeper in existing lakes than would occur under future without-project

conditions. Plan 4, with its environmental easements, would prevent 3,800 acres in the lower floodway from becoming classified as cropland lakes, as would occur under future without-project conditions.

6.117 During the second half of project life, it is highly probable that the acreage of backwater lakes in the lower floodway would continue to decline rapidly. In the backwater area, the acreage of backwater lakes would probably stay constant.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.118 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.119 The acreage of backwater lakes would decrease by 8,600 acres during the next 50 years. Approximately 3,930 acres of the total decrease would be due to sedimentation and lowering of the water levels in the Lower Atchafalaya Basin Floodway. Nearly 4,670 acres would be lost as backwater lakes and become reclassified as cropland lakes. Compared to future without-project conditions, this plan would cause the loss of an additional 600 acres due to such reclassifications and sedimentation.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.120 No impacts would occur due to operation and maintenance. Impacts due to mitigation measures would be the same as for fresh bayous, canals, and borrow pits.

Plan 9 (R)

6.121 Impacts of this plan on backwater lakes would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.122 Maintenance of existing features would have no impact on backwater lakes.

6.123 Operation of the floodway system would result in increased sedimentation in backwater lakes.

CROPLAND LAKES

PLAN 4 (EQ)

Major Impacts of Proposed Project Features

6.124 Plan 4, with environmental easements, would preserve the existing cropland lakes through 2080, but would not create any additional acreage. Compared to future without-project conditions, there would be 4,070 fewer acres of such lakes.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.125 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.126 If Plan 7 were implemented, cropland lakes would increase from the present 30 acres to 4,900 acres by 2030. This would occur as the clearing of forests caused headwater and backwater lakes to become surrounded by agricultural lands and then become reclassified as cropland lakes. The extensive clearing allowed by Plan 7 would cause 800 acres to become cropland lakes which would have remained other lake types under future without-project conditions.

6.127 During the second half of project life, the continued clearing south of I-10 would cause some of the remaining headwater and backwater lakes to be reclassified as cropland lakes.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.128 No impacts would occur due to operation and maintenance. Building Buffalo Cove management unit and purchase of 16,800 acres of bottomland hardwood forest would prevent certain existing lakes from becoming classified as cropland lakes due to land clearing.

Plan 9 (R)

6.129 Impacts would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.130 Maintenance of existing features would have no impact on cropland lakes. Operation of the floodway system would cause a more rapid sedimentation in cropland lakes.

BRACKISH AND SALINE MARSH BAYOUS, CANALS, AND BORROW PITS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.131 Brackish bayous, canals, and borrow pits would increase by 1,900 acres with this plan and under without-project conditions. This change would occur as erosion occurred in the brackish marsh. Saline bayous, canals, and borrow pits would increase by 1,300 acres, also due to erosion.

6.132 During the 2030-2080 period, acreage of both these habitat types would increase.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.133 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.134 Construction of the channel alinement of the Avoca Island levee would increase deterioration rates in the brackish marsh, which would lead to creation of approximately 200 more acres of brackish bayous and canals with this plan than under future without-project conditions.

6.135 Between 2030 and 2080 these habitat types would continue to increase.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.136 No impacts would occur.

Plan 9 (R)

6.137 Impacts would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.138 Maintenance of existing features would have no impact on these waterways. Operation of the system as a floodway would have only a minor impact on such waterways. Some would be scoured slightly deeper by fast moving currents while others would become more shallow due to sedimentation.

MARSH PONDS AND LAKES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.139 Fresh marsh ponds and lakes would increase by 54,000 acres by 2030 with this plan and under future without-project conditions. This increase would occur as fresh marsh deteriorates, erodes, and subsides naturally.

6.140 Brackish marsh ponds and lakes would expand to 75,300 acres with Plan 4 and under future without-project conditions. This increase would occur due to natural erosion of marsh.

6.141 Saline marsh ponds would increase by 34,600 acres compared to present conditions. The increase would be due to naturally occurring marsh loss.

6.142 During the second half of project life, existing trends of marsh erosion and conversion to marsh ponds would probably continue.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.143 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.144 With Plan 7 fresh marsh ponds and lakes would increase by 54,800 acres from the present and by 800 acres over future without-project conditions. The increase from present would be due to the ongoing processes of marsh deterioration and erosion while the increase from the future without-project conditions would be increased pond formation due to marsh deterioration caused by the Avoca Island levee. Plan 7 would create the largest gain in brackish marsh ponds of any plan. By 2030, there would be 21,100 more acres than exist at present and 1,000 acres more than would exist under future without-project conditions. The additional gain over future conditions would be due to construction of Reaches 3 to 5 of the Avoca Island levee, which might increase marsh loss and pond gain. Saline marsh pond acreage might also increase in 2030, because Reach 3 of the levee might cause increased pond formation. Saline ponds might increase by 34,700 acres over present and by 100 acres over the future without-project conditions. If only Reach 1 were built, an additional 100 acres of fresh marsh ponds might form and no additional brackish or saline marsh ponds would form compared to the future without-project conditions.

6.145 Trends in the 2030-2080 period would be similar to those between 1980 and 2030.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.146 No impacts would occur.

Plan 9 (R)

6.147 Trends in fresh, brackish and saline ponds would be similar to those described in Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.148 Maintenance of existing features would have no impact on marsh ponds and lakes.

6.149 Operation of the floodway system would slightly increase sedimentation in these water bodies and could also adversely affect rooted aquatic plants therein. However, the aquatic plants would probably recover quickly. A pre- and post-flood study done in Lake Pontchartrain indicated that operation of the Bonnet Carre Spillway in 1973 had little impact on submerged vegetation in the lake (US Army Corps of Engineers, 1974).

BAYS AND OPEN GULF

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.150 Deltaic growth in Atchafalaya Bay would cause the loss of 124,900 acres of fresh bay habitat if Plan 4 were implemented. This acreage is the same as that under future without-project conditions. Brackish and saline bays would be expected to show no future change with this alternative or under future without-project conditions. Open gulf waters would also be expected to stay at approximately the present 804,000 acres, both under future without-project conditions and if Plan 4 were implemented.

6.151 It is difficult to project trends from 2030-2080. Atchafalaya Bay would probably be converted entirely to delta by 2010 (Adams and Baumann, 1980) and adjacent fresh bays might begin filling with sediment. Acreage of brackish and saline bays would be expected to stay constant. Acreage of the open gulf would probably decrease slightly as the delta continued its southward growth.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.152 Operation of the widened Wax Lake overbank area would speed the loss of fresh bay habitat by increasing delta development.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.153 With this plan, fresh bays might decrease by 120,600 acres in 2030. Compared to future without-project conditions, there might be an increase of 4,300 acres of fresh bay habitat. This increase would occur because construction of the channel alinement of the Avoca Island levee might isolate portions of newly developed delta and thus cause it to deteriorate faster than it would without the levee. If only Reach 1 were built, there would be no impacts to fresh bays. As with Plan 4, brackish and saline bays, and open gulf would be expected to remain at their present acreage.

6.154 Impacts during the second half of project life would be similar to those described for Plan 4.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.155 Impacts would be the same as for Plan 4.

Plan 9 (R)

6.156 Impacts would be similar to those discussed for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.157 Maintenance of existing features would have no impact on bays and open gulf.

6.158 Operation of the floodway system would hasten the demise of Atchafalaya Bay by increasing the rate of deltaic accretion. Salinities in all bays and portions of the gulf would be decreased by the influx of floodwaters.

FLOOD-CARRYING CAPACITY

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.159 This plan would provide for safely conveying the project flood to the gulf, but because of its somewhat higher flowline and accompanying higher costs, it might require longer to achieve the desired capacity than would be the case with other plans.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.160 Maintenance of the raised protection and river levees would insure the ability of the floodway system to pass the project flood. Maintenance of the widened Wax Lake overbank area, channel training, distributary realinements and outlet controls would also contribute to the flood-carrying capacity of the project. No impacts due to mitigation measures would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.161 This plan would provide for safely conveying the project flood through the Atchafalaya Basin and the outlets to the gulf.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.162 Impacts would be the same as for Plan 4.

Plan 9 (R)

6.163 The impacts of this plan would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.164 By maintaining the existing features, the flood-carrying capacity of the Atchafalaya Basin Floodway system would be assured. Operation of the floodway would decrease flood-carrying capacity by filling it with additional sediment.

WATER QUALITY

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.165 Management units would attempt to maintain historic water levels and overflow regimes in the backswamp areas as the floodway generally becomes drier. This would support the bacterial-detritus basis of productivity and the export of fixed carbon. Channel training works in the Atchafalaya River would decrease overbank flows and the amounts of sediment entering the backswamp areas. Realinement of the Atchafalaya distributaries and closure of other canals would be accomplished for sediment control. The sediment control features would limit slightly the amount of sedimentation occurring in backswamp areas, and would help to preserve the depth and extent of existing aquatic areas. The management units would contribute very little to sediment control and appreciable sedimentation within the management units would still be expected to occur. Inundation of overflow areas for longer periods of time could prevent some aquatic areas from becoming more frequently isolated and stagnant due to lack of flushing. However, holding water within management units would generally increase retention times and decrease velocities, which would limit the physical processes of flushing and aeration. Backswamp areas which are presently subject to low dissolved oxygen conditions in the spring high water season could experience worsened oxygen problems within the management units, especially if inflowing waters do not circulate to all parts of the unit. This could occur, for example, by short-circuiting or impedance of water circulation caused by the creation of dredged-material embankments during canal dredging by the oil and gas industry. In summary, while the management unit provision of the EQ plan could have both positive and negative effects on some key water quality parameters, particularly dissolved oxygen, the units would contribute positively to water quality and water quality-related values in the Lower Atchafalaya Basin Floodway by helping to maintain the physical conditions, which would be more similar to the present than to the future without-project conditions.

6.166 The EQ plan provision proposing environmental easements over most of the floodway would prevent water quality degradation, which would occur under future without-project conditions due to the encroachment of agricultural and residential development into or adjacent to present wetland areas. Limitations on development would preserve the natural purification processes of wetlands and restrict the amount of residential wastes, storm runoff, agricultural runoff or sediment, excess nutrients, and pesticides, which the natural system would have to assimilate.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.167 Operation and maintenance of proposed features should not result in significant adverse impacts on water quality.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.168 With this plan, water quality within the upper and lower floodway areas would generally be poorer than under the EQ plan. Lower average main channel flowlines and fewer diversion routes into overbank areas would lessen their water supplies. The resultant shortening of wet periods and reduced circulation in those areas would cause reductions in dissolved oxygen and nutrient concentrations. As wetland areas became drier, there would be a gradual tendency, in the absence of legal restrictions, for lands to be cleared and converted to agricultural use. Such changes would entail a rise in the levels of pesticides and other toxicants in the lower basin. Only in the extreme southern portion of the floodway would sufficient water remain to support a highly productive aquatic ecosystem. Even there, however, a preponderance of backwater inflows would promote somewhat reduced dissolved oxygen and nutrient concentrations. Seasonal dewatering would, in turn, transport fewer nutrients downstream to the estuary.

6.169 Sediment deposition in the basin would, of course, decrease except below Morgan City, where natural delta formation would occur.

6.170 Construction of the Avoca Island levee extension would greatly limit freshwater input to the Terrebonne marshes. The utilization of one or more properly managed freshwater diversion structures through the levee would, however, be essential to the maintenance of acceptable salinity levels for preservation of existing marsh and its associated ecosystem. This plan would also encourage an increase in agricultural and urban activity in the backwater area northeast of Morgan City as a result of the lowered water levels. Without any controls, runoff from these lands would eventually impact adversely upon water quality conditions in water bodies and marshes in the southern portion of the area. Shellfish and other aquatic species would tend to uptake and concentrate pesticides, metals, and other toxicants introduced to the estuarine waters and sediments.

6.171 The widening of the Wax Lake Outlet overbank area, and the limitation of freshwater outflows to infrequent flood events would deter the freshening trend in the East and West Cote Blanche Bay areas, although the extent of this impact is difficult to predict.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.172 Operation and maintenance impacts would be the same as for Plan 4, but additional favorable impacts due to building the Buffalo Cove management unit and to water diversion measures for mitigation would occur. Some adverse impacts could result if water diversion measures introduced pollutants into areas not presently highly contaminated.

Plan 9 (R)

Major Impacts of Proposed Project Features

6.173 Water quality impacts of Plan 9 would equate to those of the EQ plan with respect to management unit operations and environmental easements in the floodway. Fee purchases and the Dow Chemical Company donation would also preserve water quality.

6.174 This plan provides for channel training in the Lower Atchafalaya River below Morgan City, as does the NED plan. This structural feature would produce a slight lowering of flowlines below those of the EQ plan, thereby contributing to a somewhat more pronounced drying trend in the backswamp areas. Although this plan provides for maintenance of the present outflow distribution from the floodway of 70 and 30 percent in the Lower Atchafalaya River and the Wax Lake Outlet, respectively, the Wax Lake Outlet portion could be reduced to 20 percent if the ecosystem's response were favorable. Such a restriction would deter somewhat the freshening trend in East and West Cote Blanche Bay. Total nutrient transport from the floodway to the estuary would probably be slightly less than under the EQ plan, as a result of more restricted flow interchange with backwater areas, and reduced outflows from the Lower Atchafalaya River directly into Atchafalaya Bay.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.175 Impacts would be the same as for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.176 Maintenance dredging would increase turbidity of the water, release nutrients, and depress oxygen levels.

6.177 Dredging below Bayou Sorrel Lock could increase the amount of pesticides available for uptake into the food web. This impact would be local and short-term.

6.178 Dredging in Berwick Harbor and Berwick Lock Forebay could increase the amounts of heavy metals and PCB's available for uptake. This impact would be local and short-term.

6.179 Barge and ship traffic along maintained waterways would cause spillage of petroleum and other products which would decrease water quality.

6.180 Painting, oiling, and greasing of control structures and locks has the potential to slightly decrease water quality in the immediate area.

6.181 Operation of the floodway would temporarily decrease the water quality in the floodway and in the estuarine area. Turbidity would be greatly increased and temperature would be decreased. Dissolved oxygen in flowing waters would be increased but the debris, detritus, and aquatic plants deposited by floodwaters could lower dissolved oxygen levels as waters recede. Operation of some of the intercepted drainage features would have adverse impacts on water quality because they would introduce waters with high pesticide content into the floodway.

NATURAL AND SCENIC STREAMS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.182 Plan 4 would have no direct construction impacts on any natural or scenic stream, nor should it have any indirect adverse impact.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.183 No impacts would occur.

Plan 7 (NED)

6.184 The scenic qualities of Bayou Penchant could be enhanced by the flood protection this plan would afford due to the Avoca Island levee extension because high water levels along this stream may be killing some of the trees along the banks.

Plan 9 (R)

6.185 Impacts would be similar to those described for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.186 Maintenance of existing features and operation of the floodway would have no significant impact on Bayou Penchant. It is possible that extra sediment carried by floodwaters could help rebuild its subsiding and eroding natural banks.

NAVIGABLE WATERWAYS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.187 Channel training works on the Atchafalaya Basin main channel, restriction of flows at Wax Lake Outlet, and management units all would have adverse impacts on navigable waters and navigation. Because channel training includes the closure of all side channels and canals except the east and west access channels, the east and west freshwater distribution channel, the Old Atchafalaya River, American Pass, and the GIWW, access to the basin's interior from the main channel would be limited to those waterways, affecting sport and commercial fishing boats as well as vessels servicing energy facilities within the basin's interior. These impacts would be for the project life.

6.188 Restriction of flows through Wax Lake Outlet would also have adverse impacts on vessels entering that waterway via the Atchafalaya Basin main channel. This too would be for the life of the project. Impacts resulting from the construction of management units would be significant for sport and commercial fishing boats and for energy facility service vessels. Artificial ringing of the management units and the closure of incoming bayous and canals would require boats or vessels entering the management unit do so via the outlet or possibly the inlet. This could involve substantial time-travel requirements. Construction of boat rollovers at some closures would partially mitigate the impacts to small boats but not the impacts to large fishing boats or other vessels.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.189 Maintenance of boat rollovers associated with the management units would assure small boat access to the interior of the units. No impacts due to mitigation measures would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.190 Training works on the Atchafalaya Basin main channel and extension of the Avoca Island levee would have adverse impacts on navigation. Similar impacts could be expected as a result of channel training below Morgan City, with additional impacts on navigation resulting from complete closure of Bayou Shaffer. Closure of Wax Lake Outlet would also have adverse impacts on vessels entering that waterway via the main channel. These impacts would last for the life of the project.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.191 Impacts would be as described for Plan 4, except that building Buffalo Cove management unit for mitigation purposes would hinder boat access in that area.

Plan 9 (R)

Major Impacts of Proposed Project Features

6.192 Navigation impacts associated with this plan would be the same as those resulting from the NED plan (except that no impacts from extension of the Avoca Island levee would occur) including impacts related to constructing management units as discussed in the EQ plan.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.193 Impacts would be the same as for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.194 The maintenance dredging in the main channel, east freshwater distribution channel, east and west access channels, Berwick Bay Harbor, Wax Lake crossing and below Bayou Sorrel Lock all contribute to keeping navigable waterways open to traffic. Maintenance of the lock structures and dredging of forebays and tailbays also keep barge and crew boat traffic flowing smoothly. Routine maintenance and repair of locks should prevent any major breakdowns and consequent long waits by vessels. Traffic is forced to use alternate routes when the locks are dewatered every 10-15 years. Travel time and costs are, therefore, increased for the few months necessary to repair the lock.

6.195 Operation of the floodway system would adversely impact navigable waterways. The swift currents would make navigation difficult or impossible in the main channel and along the floodside Alternate Route of the Gulf Intracoastal Waterway. However, the landside route is maintained for just such occurrences. High water could cause closure of various locks which would cause substantial delays in navigation (US Army Corps of Engineers, 1974).

FISHERIES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.196 To illustrate the impact of each plan on fisheries, the harvest of various species has been estimated. (The methodology used is described in Appendix A, paragraph A.6.61.) Plan 4 would permit the highest estimated harvest of freshwater sport fish in 2030 (Table 6-10). Since management units would be responsible for much of the increased fishery productivity of Plan 4, impacts of this feature are discussed separately.

TABLE 6-10

ESTIMATED HARVEST OF VARIOUS AQUATIC SPECIES IN 2030

	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
Sunfish[1/]	840.1	1,003.0	736.2	1,002.8
Largemouth Bass[1/]	289.9	343.0	255.7	342.9
Shrimp[2/]	46.8	46.8	46.5	46.7
Menhaden[2/]	170.0	169.9	169.0	169.7
Oysters[3/]	2.2	2.2	2.2	2.2

[1/] Harvest, thousands of fish, Lower Atchafalaya Basin Floodway.

[2/] Harvest, millions of pounds, entire project area.

[3/] Harvest, thousands of pounds, entire project area.

6.197 Management units would maintain water levels in lakes and bayous higher than would occur under future without-project conditions, and would also retain water on the land longer. Compared to future without-project conditions in 2030, units would flood land an average of about 3 to 4 weeks longer from mid-March to mid-May and 2 months longer from January through July. Both the additional depth and longer flooding period would create fishery habitat that would not exist under future without-project conditions. This overflow habitat which would be created would be exceedingly valuable to crawfish and finfish, especially juveniles. Crawfish are dependent on seasonal water level fluctuations to produce high populations. Seasonal water levels within management units would fluctuate more than within the same areas under future without-project conditions. However, day to day fluctuations would be less than they are under present conditions. Severe sedimentation would still occur with units; therefore, the present crawfish harvest would not be maintained. Under future without-project conditions, the maximum sustainable yield has been predicted to drop 39 percent from present levels, but with Plan 4 the decline would be reduced to 28 percent. By retaining higher water levels, units would prevent delay in production of juvenile crawfish and cannibalism of young in burrows.

6.198 By keeping forests flooded for additional time, small fish would be able to stay longer in this nursery area and would therefore, be larger and more able to escape predators as their habitat became restricted by falling water levels. Management units would preserve aquatic habitat in the summer, and these areas would become available for fish as higher temperatures made shallower areas uninhabitable. Management units would flood more forestland than would be flooded under future without-project conditions. Flooding these forests would increase the amount of detritus available to the system and, thereby, increase fishery productivity (Mitzner, 1981).

6.199 At present, the flooding and dewatering of the basin plays a vital role in the cycles of distribution of phytoplankton, zooplankton, and benthos throughout the system. The restriction of flow caused by management units may slow these cycles. However, compared to future without-project conditions, construction of management units would preserve the cycle as the basin dries out. This restriction of flow would probably reduce the amount of organic matter exported to the system downstream. Brinson (1976) has shown a positive correlation between organic matter export and runoff for several watersheds. Thus, management units would probably reduce export compared to the present, but would provide more export than would occur under future without-project conditions. Thus, on balance, management units would be beneficial to the aquatic ecosystem.

6.200 As discussed under headwater lakes, there is doubt that management units could actually preserve present water levels. In that case, the harvest estimates for freshwater species shown in

Table 6-10 are best-case estimates. In Buffalo Cove and Cocodrie Swamp where future levels may be temporarily higher than exist at present, groundcover might be reduced, and the loss of this potential detritus could slightly decrease fishery productivity. If water levels in Henderson and Flat Lakes drop below those at present, the outlets may be restricted to maintain water levels. However, this could cause a lowering of dissolved oxygen and a decrease in fishery productivity.

6.201 Widening of the Wax Lake overbank would have a beneficial impact on fisheries. As the existing levee is degraded, 7,800 acres of cypress-tupelo forests would be reconnected to the river and tidal systems and its detrital output would be available over a larger area. Also, as these forests flooded, more fishery habitat would be available.

6.202 During levee construction, some existing borrow pits would be filled with material for the levee, thus destroying all organisms in them. However, Plan 4 would cause a net increase of 12,090 acres of borrow pits, which would increase fishery productivity. Construction of borrow pits would create temporary turbidity that would have a short-term, minor impact on fisheries. Construction of levees would destroy approximately 5,500 acres of flooded forest and the detritus these forests produce would be permanently lost.

6.203 Bank stabilization of the Atchafalaya main channel after 1980 would temporarily disrupt 1,300 acres; however, these areas should return to benthic production within 1 year. (Prior to 1980, approximately 1,100 acres were disrupted.) The concrete revetments and riprap used for stabilization would harbor different organisms than the existing mud banks, but post-construction productivity should be similar to that of pre-construction times. Channel training along 17.6 miles of the Atchafalaya River would create additional fishery habitat as the river is deepened. However, this would not be a high quality habitat because of swift currents and high turbidity. The placement of dredged material over 2,670 acres of river banks would destroy habitat that is presently available to aquatic animals during high water. Realinement of distributaries would create temporary turbidity and destroy some aquatic habitat while creating more. On the whole, direct construction impacts of the sediment control feature should be minimal. Construction of inlets and outlets for management units would have only a minor impact to fisheries. If levees are required along the border of some units, these levees would remove some presently flooded land from the aquatic system. Direct construction impacts of widening the Wax Lake Outlet overbank would be more than compensated for by the beneficial impacts stated previously.

6.204 By far the most important commercial fishing resource in the Lower Atchafalaya Basin Floodway is the crawfish, which accounts for approximately 78 percent of the ex-vessel value of the total fishery

harvest. The maximum sustainable yield (MSY) of crawfish in the lower floodway is currently estimated at 43 million pounds per year (Bell, 1981), which is considerably in excess of current demand. Projections of demand indicate that by 1992, the demand will exceed potential MSY. Table 6-11 shows how the potential crawfish MSY in the lower floodway is expected to decrease over time under different scenarios. Plan 4 (and 9) would create conditions which would permit the greatest MSY in 2030 of any plan, although there would be a decrease of 28 percent from 1986 harvest levels.

TABLE 6-11

MAXIMUM SUSTAINABLE YIELD FOR WILD CRAWFISH
IN THE LOWER ATCHAFALAYA BASIN FLOODWAY
(million of pounds)

Year	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
1986	43.00	42.22	43.00	42.22
2036	26.11	30.60	22.24	30.58
Difference	-39%	-28%	-48%	-28%

6.205 In general, all primary commercial species (crawfish, catfish, and buffalo fish) would suffer a decline in MSY in the future. Table 6-12 describes the net income of commercial fishermen in the Atchafalaya Basin Floodway under different alternatives. Again, it can be seen that Plan 4 (and 9) would allow the commercial fishermen the highest net income of all plans.

TABLE 6-12

NET INCOME OF ATCHFALAYA BASIN FLOODWAY
COMMERCIAL FISHERMEN UNDER DIFFERENT ALTERNATIVES
(in millions of 1980 dollars)

Year	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 R
1986	2.80	2.80	2.80	2.80
1996	5.47	5.80	5.20	5.79
2006	7.30	8.31	6.86	8.31
2016	8.69	10.38	7.77	10.37
2026	10.16	12.02	8.74	12.02
2036	10.73	12.57	9.14	12.57

6.206 On the whole, the EQ plan would be the best for preserving the fishery resource. It would allow the harvest of more freshwater fish and shellfish than would occur under future without-project conditions. It would be the best of any plan except future without-project conditions to preserve the estuarine fishery.

6.207 During the second half of project life, aquatic habitat in the Lower Atchafalaya Basin Floodway would probably continue to disappear. The management units would probably continue to function. Within the marsh it is even more difficult to predict the fate of fisheries. Marsh degeneration would probably continue as the result of natural causes, and fishery losses would parallel those of the marsh losses.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.208 Operation and maintenance of the proposed features would have no significant impact on fisheries.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.209 Compared to future without-project conditions, Plan 7 would cause a loss in fishery resources in the Lower Atchafalaya Basin Floodway (Table 6-11), the backwater area, and the estuarine area. Compared to other plans, the NED plan would bring about the lowest overall fishery productivity.

6.210 In the lower floodway, sedimentation would continue, but since no management units are included in this plan (except for mitigation purposes in Buffalo Cove), even the 1,500 acres of lakes they would preserve would be lost. As the management unit areas became ringed off by sediment deposits, water quality problems might occur. The increased agricultural production in the lower floodway would introduce sediments and pesticides that would reduce fisheries production. All these conditions would contribute to the loss of fisheries (Tables 6-10 and 6-11). The estimated MSY for crawfish would be 48 percent lower than for 1986 conditions and 9 percent lower than for future without-project conditions (see Table 6-11). Plan 7 would create conditions which would leave the commercial fishermen with the lowest net income of any plan.

6.211 The fishery in the backwater area northeast of Morgan City is much less productive than that of the lower floodway. As land clearing proceeded, the additional pesticides and sediments that would be introduced into the water would cause a decrease in fish production. The increased turbidity could be especially detrimental to the sport fish in Lake Verret.

6.212 In the marshes, channel alinement of the Avoca Island levee would cause a loss of marsh and delta, and hence the greatest fishery loss of any plan. Table 6-10 shows estimated harvests of various estuarine-dependent fish and shellfish if the entire Avoca Island levee extension were built with Plan 7. Marsh and delta loss caused by construction of the Avoca Island levee would reduce fisheries over future without-project conditions. Supplemental water would prevent any more salinity intrusion into the Terrebonne Parish marshes than would occur without the project, but the fisheries resource would still decline compared to future without-project conditions.

6.213 Impacts of other features would be similar to those described under Plan 4, with the exception that levee raising would create 13,220 acres of borrow pits, one of the few fishery benefits of the entire plan. Approximately 5,300 acres of wooded wetlands would be destroyed, which would remove these areas from the aquatic ecosystem permanently. Direct construction impacts of channel training below Morgan City would decrease fishery resources. These channel training works would also decrease the flow of sediment, nutrients, and water to the marshes and forests along the Lower Atchafalaya River and Wax Lake Outlet. This would reduce fisheries productivity by causing losses of marsh and aquatic habitat. The widening of Wax Lake Outlet overbank would have beneficial effects as described for Plan 4.

6.214 Conditions from 2030 to 2080 would be similar to those described under Plan 4, but sedimentation in the Lower Atchafalaya Basin Floodway would be even more severe and the remaining lakes would be classified as cropland lakes. As clearing proceeded below I-10,

the remaining water bodies would have increased levels of pesticides and sediments which would further degrade water quality and fisheries.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.215 No significant impacts due to operation and maintenance would occur. Impacts due to mitigation measures would occur because of building Buffalo Cove management unit and preserving 16,800 acres of bottomland hardwood forest which would offset project-induced fisheries losses (see discussion on the impacts of the major project feature of Plan 4 above). The freshwater diversion into swamplands and marsh outside the basin would also offset fisheries losses attributable to this plan.

Plan 9 (R)

Major Impacts of Proposed Project Features

6.216 Impacts to fisheries would be similar to those described for Plan 4. In the lower floodway and backwater area, impacts should be nearly equal. Channel training below Morgan City would have the same adverse effects described for Plan 7.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.217 Impacts would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.218 Slow, small benthic organisms would be destroyed both by dredging and by disposal in the waterways. Larger benthic organisms would leave the area and escape harm. If the covering of dredged material were less than 20-30 cm, most burrowing organisms would free themselves (Slotta and Williamson, 1974; Oliver and Slattery, 1976). Repopulation of dredged areas is usually quite rapid and population density and diversity should be restored in 6 months to 1 year. In shallow areas, aquatic plants would be destroyed by dredging.

6.219 Turbidity due to river disposal would adversely affect fish spawning and rearing areas, impact development of juvenile fish and crustaceans, and interfere with filter-feeding fish and zooplankton. Turbidity would also decrease light penetration which would reduce primary productivity.

6.220 Barge traffic would create constant stress on benthic organisms and would limit diversity and abundance.

6.221 Removal of debris from canals and channels would remove fishery habitat and could decrease the fishery productivity of the area.

6.222 Dewatering of locks at 10-15 year intervals would destroy the fish and shellfish trapped within the locks. This would be a minor and infrequent impact.

6.223 The riprap and articulated concrete mattresses to be placed in the Old River Outflow Channel would temporarily destroy some benthic organisms. However, the new habitat would be populated with a different community within 1 to 2 years.

6.224 Operation of the picket boat and radar system at Old River should prevent any barges from being drawn into the low-sill structure. This would have a beneficial impact on fisheries because when a barge accident occurs, the low-sill structure would be closed as far as possible and the amount of water entering the basin would be drastically reduced. This reduction in water would have a significant adverse impact on fisheries by reducing both available habitat and nutrients.

6.225 Operation of the floodway system would have varying impacts on the basin. Many benthic organisms would be destroyed by scouring or by the high quantities of sediment deposited during flooding. Clams, snails, and worms would be the most severely affected (US Army Corps of Engineers, 1973). The nutrients and detritus carried by the floodwaters would increase the fishery productivity of the basin. All levels of the food web would be benefited. The amount of available aquatic habitat would be greatly increased. Thus, more young fish would be produced and more would survive. Certain commercial fish such as catfish, freshwater drum, and buffalo would do exceptionally well after prolonged flooding (Viosca, 1927). Crawfish populations would respond immediately to flooding and catches would be far higher than normal. On the whole, operation of the floodway system would greatly benefit fisheries on a short-term basis. Over the long term, however, operation would have adverse impacts due to loss of habitat due to sedimentation.

6.226 In the coastal zone, most estuarine and marine fish and shellfish would move gulfward ahead of floodwaters. The colder waters and low salinities would adversely influence production of brown shrimp (Barrett and Gillespie, 1973). The indigenous estuarine plankton apparently would remain in the area, but populations would be augmented by freshwater forms (Hawes and Perry, 1978).

6.227 The nutrients carried by the flood would increase productivity of some estuarine species. However, Odum and Wilson (1962) and Odum et al. (1963) found only small changes in total metabolism of coastal waters due to flooding in Texas.

6.228 The increased turbidity in coastal waters caused by operation of the floodway would reduce the amount of phytoplankton present; however, extra nutrient input would probably counteract this.

6.229 Operation of the floodway could also prevent or delay the influx of the juvenile animals that enter the estuarine system in order to mature. Another adverse impact would be that oyster mortality would increase in the Terrebonne Parish oyster beds due to the large influx of fresh water.

6.230 On the whole, the impact of operation of the floodway system on estuarine fisheries would be beneficial.

WILDLIFE

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.231 With this plan, there would be a slight decrease in certain wildlife resources of the project-affected area in the future. The primary reasons would be the gradual deterioration of the marshlands in Terrebonne Parish and direct destruction of habitat caused by construction during the first decade of project life. It should be noted, however, that plan implementation would cause a highly significant net gain in these resources when compared to what would exist under future without-project conditions. To illustrate the magnitude of these changes, theoretical estimates of population levels of nine representative species were calculated for present and 2030 conditions (Table 6-13). Differences between 2030 levels under future without-project conditions and future with plan conditions were also calculated (Table 6-14). Losses or gains in numbers compared to future without-project conditions are discussed for each of these nine species individually. Other species having similar habitat needs are also discussed. (It should be cautioned that determination of population levels of most species of wildlife is a very inexact procedure. The estimates provided were calculated from data obtained from a survey of literature and from the professional judgment of several biologists.

TABLE 6-13

ESTIMATED POPULATION LEVELS OF REPRESENTATIVE
WILDLIFE SPECIES IN 1980 AND 2030

Species	1980 Population	2030 POPULATION			
		FWO	With Plan 4	With Plan 7	With Plan 9
White-tailed Deer	12,400	10,700	14,900	10,200	14,900
Swamp Rabbit	371,000	387,000	393,000	385,000	393,000
Black Bear	50	0	More than 50	0	More than 50
Wood Duck[1/]	15,000	14,000	14,000	11,000	14,000
American Robin	453,000	295,000	469,000	289,000	470,000
Clapper Rail	393,000	267,000	267,000	265,000	267,000
Bobwhite Quail	15,000	34,000	16,000	39,000	16,000
Mink	73,000	63,000	73,000	60,000	73,000
Red-eyed Vireo	1,658,000	1,182,000	1,634,000	1,141,000	1,639,000

[1/] Resident birds only.

TABLE 6-14

ESTIMATED DIFFERENCE BETWEEN 2030 POPULATION LEVELS OF REPRESENTATIVE WILDLIFE SPECIES UNDER FUTURE WITHOUT-PROJECT AND FUTURE WITH PROJECT CONDITIONS

Species	With Plan 4	With Plan 7	With Plan 9
White-tailed Deer	+4,200	-500	+4,200
Swamp Rabbit	+6,000	-2,000	+6,000
Black Bear	+ More than 50	0	+ More than 50
Wood Duck[1/]	0	-3,000	0
American Robin	+174,000	-6,000	+175,000
Clapper Rail	0	-2,000	0
Bobwhite Quail	-18,000	+5,000	-18,000
Mink	+10,000	-3,000	+10,000
Red-eyed Vireo	+452,000	-41,000	+457,000

[1/] Resident birds only.

These estimates should be used for comparative purposes only. They do not necessarily represent actual population levels.)

DEER

6.232 Net project-induced gain in deer population would be an estimated 4,200 animals. The primary reasons would be the environmental easement feature of this plan, and the gradual drying of the lower floodway which would result as the Atchafalaya River matures. Reduction in extent and duration of flooding coupled with plant successional processes should improve habitat quality for both deer and other primarily terrestrial animals, such as the box turtle or the seasonally abundant white-throated sparrow, which could lead to population increases in these species. It should be noted that the management unit feature of this plan would prevent these improvements in habitat quality in the areas where units would be built.

SWAMP RABBIT

6.233 Net project-induced gain in swamp rabbit populations would be an estimated 6,000 animals. As in the case of deer, these animals would benefit somewhat from a reduction in the extent and duration of flooding as long as flooding was not eliminated completely and from the environmental easement feature of this plan which would preserve habitat. Moreover, these animals would greatly benefit from the new habitat created as the Atchafalaya delta enlarges.

BEAR

6.234 With Plan 4 in effect, bear populations would be maintained within the project-affected area, and they could possibly expand into habitat not presently occupied. Under future without-project conditions, bears would undoubtedly be eliminated entirely. A similar situation exists for wild turkey, although under future without-project conditions a remnant population might persist in the southern basin.

WOOD DUCK

6.235 There would probably be no net project-induced gains or losses in resident wood duck population levels with Plan 4. The reason for this is that the primary limiting factor for resident wood duck populations is the amount and quality of brood-rearing habitat. Under future without-project conditions, there would be large losses of potential wintering habitat for migrant wood ducks but much smaller losses of brood-rearing habitat. Plan 4 would, however, benefit migrant wood duck populations by preserving much of the seasonally flooded bottomland hardwood areas, which are heavily utilized during the winter months. Similar benefits would accrue to other migrant ducks, such as the mallard.

AMERICAN ROBIN

6.236 There could be a highly significant estimated net project gain of about 174,000 individuals with Plan 4. Preservation of bottomland hardwood areas with this plan would be the primary reason. Similar benefits would accrue to other migratory winter resident songbirds that utilize the project-affected area.

CLAPPER RAIL

6.237 With Plan 4, there would be no net project-induced loss of clapper rails, birds of the brackish and saline marshes. Overall population levels would continue to decline as the coastal marshes continue to deteriorate. Similar changes might occur in populations of other rail species that inhabit the fresh marshes as well as to furbearers such as the nutria and muskrat.

BOBWHITE QUAIL

6.238 With this plan, there would be an estimated net project-induced loss of about 18,000 birds. The reason for this would be the prevention of land clearing, which would occur if Plan 4 were implemented. Similar impacts would also occur to populations of other animals of open land or farm areas.

MINK

6.239 There would be an estimated net project-induced gain of about 10,000 animals. This gain would largely be due to the preservation of bottomland hardwood and cypress-tupelo forests, which Plan 4 would insure.

RED-EYED VIREO

6.240 This small summer-resident songbird could benefit greatly from Plan 4. An estimated net project-induced gain of 452,000 individuals could occur. This gain would result almost exclusively from the prevention of forest clearing that this plan would insure. Similar gains would also be expected to accrue to other species of forest-dwelling songbirds.

6.241 During the construction phase of the project, most sedentary or slow-moving animals living in construction areas would be killed immediately while more active species, forced to flee the area, would probably ultimately die. Certain structural features of this plan could also cause increased animal mortality throughout project life. Probably the most damaging from this standpoint would be the use of sheet-pile and I-wall construction to raise the protection levees. This type construction prevents passage of animals and is particularily damaging to semi-aquatic species, such as turtles, which must seek nesting areas on dry land away from the floodway. These walls could also be highly disruptive to deer and other larger animals

during times of extreme high water when they are forced to flee the floodway to seek dry ground.

6.242 With Plan 4, net income to trappers would increase from about $185,000 in 1980 to $186,000 in 2030. This would be a value of about $16,000 greater than would be expected under future without-project conditions.

6.243 Overall population levels of some species of wildlife would probably continue a slow decline in the post 2030 period of project life. The natural deterioration of the Terrebonne Parish marshes, due to subsidence and erosion, would continue. Within the backwater area northeast of Morgan City, urban and industrial encroachment upon wetland areas, would probably continue, and this would have adverse impacts upon wildlife populations. Within the floodway proper, overall population levels would probably stabilize, although increases in numbers of certain species might occur as forest succession proceeded to a more mature stage. On the other hand, continued loss of wetland areas would cause water-dependent animals, such as wading birds, to continue to decline. By the year 2080, the basin would probably become an "island" of forested habitat surrounded by urban and agricultural land and as such, it would be of immense value to wildlife.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.244 Any loss of forest habitat caused by maintenance of proposed project features would be reflected in a loss in wildlife. Such impacts are expected to be minor. Mowing of the levees could disturb ground-nesting birds and destroy young or slow moving animals. Policing of the lands on which easements have been taken would prevent unauthorized land clearing and preserve wildlife habitat.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.245 With this plan in effect, there would be a highly significant decrease in most wildlife resources of the project-affected area in the future. The primary reason for this decline would be the loss of existing bottomland hardwood habitat, both within the floodway proper and in the backwater area northeast of Morgan City. Additional losses would occur due to environmental degradation caused by pollution of the remaining forested habitats, the result of expanded urban and agricultural activities and to extension of the Avoca Island levee. To illustrate the magnitude of these losses, estimates of population levels of representative species are examined, as was done in the case of Plan 4 (see Tables 6-13 and 6-14 for a comparison of plans).

DEER

6.246 There would be an estimated net project-induced loss of about 500 deer by the year 2030. This loss would be almost entirely due to loss of bottomland hardwood forests caused by clearing of these areas for agriculture. By 2030, most of the higher quality deer habitat now present in the project-affected area would no longer exist.

SWAMP RABBIT

6.247 Estimated net project-induced losses in swamp rabbit population would be 2,000 animals. The reason for these losses would be the same as that described for deer.

BEAR

6.248 Bear would probably cease to exist within the project-affected area by 2030. Thus, with Plan 7, the situation would be the same as under future without-project conditions.

WOOD DUCK

6.249 Estimated net project-induced losses to resident wood duck populations would be about 3,000 birds. Loss of brood-rearing habitat would be the primary reason for this decline. Project losses to migratory wood duck population would be even higher than under future without-project conditions because Plan 7 would eliminate much of the seasonably flooded forestland that these birds need for survival during winter. Similar losses to other migratory species, such as the mallard, would occur.

AMERICAN ROBIN

6.250 Estimated net project-induced loss to populations to the American robin could be about 6,000 birds, Loss of forest habitat would be the cause, and similar decreases would occur in populations of other winter-resident, migratory songbirds that are dependent upon this type of habitat.

CLAPPER RAIL

6.251 There would be an estimated net project loss to clapper rail populations of about 2,000 birds. Plan 7 would be more destructive than any other plan to marsh-dwelling forms of wildlife, such as the rails, and also to furbearers, such as the nutria. The reason for this is the channel alinement of the Avoca Island levee, which would affect delta development and accelerate marsh losses in the Terrebonne Parish marshland area.

BOBWHITE QUAIL

6.252 There would be an estimated net induced project gain in bobwhite quail populations of about 5,000 birds. This and other species of wildlife that utilize farmlands and other open areas would benefit from this plan.

MINK

6.253 Estimated net project-induced losses of 3,000 animals would occur due to reduced forestland, swamp, and marshland habitat.

RED-EYED VIREO

6.254 Plan 7 would be extremely damaging to these summer-resident songbirds. An estimated net project-induced loss of 41,000 individuals could result, primarily from forest loss associated with agricultural expansion.

6.255 Other impacts similar to those described for Plan 4 would also occur with this plan due to construction activity and structural features such as erection of sheet piling.

6.256 With Plan 7, net income due to commercial trapping would decrease from $185,000 in 1980 to $163,000 in 2030. This change represents a loss of about $7,000 of net revenue when compared to future without-project conditions in 2030.

6.257 The overall decrease in population levels of wildlife that would occur from 1980 to 2030 would continue in the post-2030 period. As the lower floodway continued to become drier, due to maturation of the Atchafalaya River and to sedimentation in wetland areas, continued land clearing for agriculture would no doubt occur; therefore, by 2080, only remnants of the unbroken forest and swampland

that exists today would be found. This habitat loss would cause population decreases in most forms of wildlife, which would be similar to what would happen under future without-project conditions. In the marshland areas of the project-affected area, the completed Avoca Island levee would continue to cause accelerated land loss in Terrebonne Parish. It is probable that much of the existing marsh in that area would be converted into open water. Corresponding losses in marsh dependent wildlife would occur.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.258 Operation and maintenance impacts would be similar to those of Plans 4 and 9; however, policing of the real estate easement features of this plan would not produce significant benefits in terms of preventing habitat loss since these easements would not prevent land clearing for conversion to agricultural uses.

6.259 Project-induced losses would be offset by mitigation measures such as preservation of 16,800 acres of bottomland hardwood forest, preservation of forest and aquatic habitat due to the building of Buffalo Cove management unit, and freshwater diversion into swampland and marshland outside the basin.

Plan 9 (R)

6.260 The impacts of Plan 9 upon wildlife resources would be similar to those of Plan 4 (Tables 6-13 and 6-14). However, additional construction needed for channel training on the Lower Atchfalaya River and Wax Lake Outlet would cause slight changes in the population levels of certain species. Species requiring old growth forests would not be benefited as much by this plan as by Plan 4, since it would preserve little land which would not be subject to lumbering activities.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.261 Less mobile species of wildlife would be destroyed by maintenance dredging activities. Mobile species would be forced to go to adjacent areas where it is unlikely that they would survive. As disposal areas revegetated, they would again be available as wildlife habitat, but annually used disposal areas would probably never become valuable habitat since they would be perpetually in early stages of succession.

6.262 If wildlife fed on any disposal areas polluted with heavy metals or pesticides, these materials could cause the death or injury of the animals or affect their offspring. Carnivores would be the most likely to accumulate high levels of these toxic substances.

Noise related to maintenance of existing features would have only minimal impacts. Mowing of the levees could disturb some ground nesting birds or destroy slow-moving or young animals.

6.263 Operation of the floodway system would have adverse impacts on most wildlife species. Wildlife would be subjected to two basic kinds of stress, one from the initial surge of floodwaters and the other from crowding and isolation of populations by rising waters. Deer, rabbits, opossums, raccoons, and others all would be forced to leave their home ranges and would utilize the levees and other high ground (Yaeger and Anderson, 1944; US Army Corps of Engineers, 1973). During the 1973 operation of the floodway, 150 to 200 of the estimated 5,000 to 6,000 white-tailed deer in the basin were killed. Reproductive success was also reduced that year. The loss was reduced because of rescue efforts by state and Federal agencies. Similar losses could occur in the future. Concentration of deer on the levees would subject them to harassment, predation, and starvation. On the other hand, mammals such as the raccoon and mink, that feed on aquatic animals would be benefited by flooding.

6.264 Small mammal populations would be severely affected. Blair (1939) found essentially no small mammals in a stream bottom 1 year after flooding. McCarley (1959) found that prolonged flooding had a severe impact on mouse populations. Observations in the basin after the 1973 flood indicated that virtually all mice were killed (US Army Corps of Engineers, 1973). Within a year, such populations should regain their preflood populations.

6.265 Salamander and lizard populations would be severely depleted by operation of the floodway because they are very poor swimmers. Turtle egg laying would be adversely affected by high water, but the percentage survival of young actually hatched would be high.

6.266 There would be few adverse impacts to most birds due to operation of the floodway. Most would simply leave the flooded area. However, ground nesting birds such as turkey and quail would have their eggs and nests destroyed. (Approximately 90 percent of the 1973 turkey hatch was lost.) Ground feeding birds, such as towhees, would be adversely affected. Wading birds would be benefited by the increase in fish and crawfish caused by the flood. Carrion-consuming birds would also have an increased food supply because of flood-induced animal mortality.

ROOKERIES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.267 Plan 4 would have beneficial impacts upon rookeries because it would permit the acquisition of protective easements on up to 500 acres of such sites. The management unit and environmental easement features of this plan would also benefit rookeries by providing more feeding habitat for the various wading birds using rookery sites than would be the case under future without-project conditions. On the other hand, the recreational development features of the plan would increase annual use of the lower floodway by over 1 million user days. This increased human presence could have adverse impacts due to illegal hunting or to persons attempting to enter rookery sites during the nesting season.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.268 Operation and maintenance of proposed features would have a minor impact on rookeries. Policing of the area to prevent unauthorized land clearing and poaching would benefit rookeries. No impacts due to mitigation measures would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.269 This plan would have no beneficial impacts on rookery sites. It would not protect feeding habitat as well as Plan 4, and the agricultural expansion that it would allow would result in increased pollution of the wetland areas needed as feeding sites by the adult birds. This increased pollution would have a detrimental effect but the extent is not quantifiable. The recreational development features of this plan would have the same disruptive impacts as those of Plan 4. Additionally, channel training of the Lower Atchafalaya River during the first decade of project life could directly disturb four rookery sites.

6.270 During the second half of project life, this plan would have an increasingly detrimental effect upon rookery sites and the birds that use them because of continued expansion of agricultural activity that this plan would permit.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.271 There would be no rookeries on the 1,500 acres of recreational lands; therefore, operation and maintenance would have

no impact. Building Buffalo Cove management unit and preserving 16,800 acres of bottomland hardwood forest would benefit certain rookeries by preserving feeding habitat needed by adult birds using the rookeries. Water diversion into marsh and swamplands outside the basin for mitigation purposes would likewise benefit rookeries by increasing the productivity of feeding habitat used by adult birds.

Plan 9 (R)

6.272 This plan would have the same impacts as Plan 4 except that it could also cause disturbance of four rookery sites along the Lower Atchafalaya River due to the channel training features that would be built during the first decade of project life.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.273 Maintenance of existing features would have only a minor impact on rookeries. It is possible that heavy metals or pesticides resuspended by maintenance dredging could adversely affect birds using rookery areas. The rookeries in Sweetbay Lake south of Morgan City would be the ones most likely to be affected.

6.274 Operation of the floodway system would increase wading bird productivity by increasing the number of fish and shellfish upon which wading birds feed.

AUDUBON SOCIETY BLUE LIST SPECIES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.275 Generally, Plan 4 would benefit most Blue List species when compared to future without-project conditions since it would preserve existing forestland habitat.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.276 Operation and maintenance of proposed features would have a minor impact on Blue List species. Policing of the land to prevent unauthorized clearing and poaching would protect Blue List species.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.277 Generally, this plan would be detrimental to most Blue List species particularly those inhabiting marshlands and bottomland hardwood forests. Loss of habitat due to marsh deterioration and land clearing for agriculture, coupled with increased pollution and decreasing water levels caused by this plan, would be the primary reasons.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.278 Few Blue List species would inhabit the 1,500 acres of recreational lands so operation and maintenance of these lands would have little impact.

6.279 Beneficial impacts due to mitigation measures would occur due to the building of the Buffalo Cove management unit, preserving 16,800 acres of bottomland hardwood forest, and water diversion into marsh and swampland outside the basin. These actions would preserve and raise the productivity of the habitat of many forest dwelling species.

Plan 9 (R)

6.280 The impacts of this plan would be almost identical to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.281 Maintenance of existing features would have a minor impact on Blue List species that utilize forested areas. Dredged material disposal which would create pioneer early successional communities would slightly decrease available forest habitat.

6.282 Operation of the floodway would benefit species that depend on the aquatic ecosystem for their food. Ground-nesting or feeding species would be adversely impacted, but the impact should not cause a permanent decline in population levels.

ENDANGERED AND THREATENED SPECIES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.283 With this plan, 11 of the 16 kinds of endangered and threatened species which may occur within the project-affected area would not be affected at all. Six would be affected beneficially and four would be affected adversely by various project features. The net impact of these beneficial and adverse impacts would be that two species, the Arctic peregrine falcon and Bachman's Warbler could be affected benefically while two species, the ivory-billed woodpecker and the Florida panther, could be affected adversely. The primary reason for beneficial impacts would be the environmental easement feature of this plan, which would preserve needed habitat and prevent increased pollution. Potential adverse impacts could arise primarily due to the increased human presence within the area, which would be brought about by the recreational development features of this plan. This could lead to increased harassment and possible death or injury due to shooting. Additional details on impacts to endangered species are found in Appendix H.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.284 Operation and maintenance should have negligible impacts.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.285 With Plan 7, 10 of the 16 kinds of endangered and threatened species would not be affected at all. Six would be affected adversely due primarily to either a loss of habitat or increased pollution occuring as a result of expanded agricultural activity within the Lower Atchafalaya Basin Floodway. These six are the ivory-billed woodpecker, the Arctic peregrine falcon, the bald eagle, the brown pelican, Bachman's Warbler, and the Florida panther. No species would be beneficially affected by this plan to any significant degree.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.286 Water diversion as a mitigation measure would benefit both marsh and swamp dwelling species. Purchase of 16,800 acres of bottomland hardwood forest for a public hunting area could benefit the ivory-billed woodpecker, Bachman's warbler, and the Florida panther by preserving needed habitat, but increased hunting could lead to accidental or deliberate shooting of the ivory-bill and the panther.

Creation of the Buffalo Cove management unit could also benefit the above mentioned species. Operation and maintenance should have minimal impacts.

Plan 9 (R)

6.287 The impacts of this plan would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Project Features (All Plans)

6.288 Operation of the floodway during a major flood could have significant impacts upon several species. All marsh dwelling forms would be benefited by the floodwaters, which would overflow the marshes and contribute toward increasing their long-term productivity as well as the aerial extent of the delta marsh habitats. Floodwater caused mortality of bottomland hardwood trees could benefit the ivory-billed woodpecker by creating additional feeding habitat. On the other hand, floodwaters could adversely affect the Florida panther by direct inundation of land areas and by causing a reduction in its principal food source, the white-tailed deer, as well as other smaller prey species.

RECREATIONAL FEATURES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.289 With this plan, total existing recreation user-days in the project-affected area would increase in the future by 1,272,000 so that by the year 2030, there would be 1,541,000 annual recreation user-days available. This is an increase of 1,321,000 recreation user-days over future without-project conditions and represents an average annual net worth increase of $18,338,000. Plan 4 would cause a major increase in recreation user-days due to the environmental easement features that prevent land clearing and conversion in the lower floodway and backwater area; and it would also provide for access to lands therein, which would be managed or developed to enhance recreational use.

6.290 The impacts of this plan on the total number of water surface acres of supply available to support boating activities versus acres needed over the project life were comparatively analyzed (see Appendix F of this report). This analysis revealed that water surface acreage losses would not preclude future use, based upon existing and proposed boat-launching access and available water surface acres of supply. Losses would, however, decrease the quality of the outdoor

experience as headwater and backwater lake acreage would be lost, causing a shift in future use concentrations to the less preferred bayous and canals.

6.291 Data are not available to forecast exact conditions beyond the year 2030, but if trends continue into the future, recreational use potential in the lower floodway would increase slightly over time. This increase would result from the natural succession of certain habitat type acreage to a type with higher recreational use potential. Marsh acreage would, however, continue to decline, lowering associated user-day potentials. Because much land outside the floodway in the region would probably be cleared for agricultural purposes, the nonconsumptive recreational use potential in the floodway would probably increase because of the nonavailability of the resource elsewhere. Use occurring on the developed recreational features proposed by this plan would remain constant and at optimal design-carrying capacity levels.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.292 Operation and maintenance of proposed features would have a beneficial impact on recreation features. Maintenance of the boat rollovers into the management units would allow access by fishermen and hunters. The policing of the lands protected by easements would prevent unauthorized land clearing and preserve the existing forests. Preservation of such forests would maintain existing and future recreation potentials.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.293 With this plan, total existing recreation user-days in the project-affected area would increase in the future by 962,000 so that by the year 2030, there would be 1,231,000 annual recreation user-days available. This increase of 1,011,000 recreation user-days over future without-project conditions represents an average annual net worth increase of $16,462,000. Losses of recreation user-days are attributed to extensive clearing of forestlands for agricultural purposes in both the lower floodway and backwater area; to the natural process of marsh deterioration; and to the Avoca Island levee extension, which would directly interfere with delta development and increase marsh deterioration. Increases in recreation user-days under this plan would result from the fee acquisition of 1,500 acres for recreational development. Impacts of this plan on water-based recreational activities are the same as those of Plan 4.

6.294 Data are not available to forecast conditions beyond the year 2030, but if land clearing continued throughout the remainder of the

project life, at least 25,000 additional acres of forestland would be cleared resulting in an additional loss of at least 9,500 annual recreation user-days worth $286,000.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.295 Operation and maintenance of proposed features would be similar to that described for Plan 4, however, there would be considerably less recreation land to police. Mitigation measures would make available for recreational use, about 16,800 acres of bottomland hardwood forest for a wildlife management area.

Plan 9 (R)

Major Impacts of Proposed Project Features

6.296 With this plan, total existing recreation user-days in the project-affected area would increase in the future by 1,055,000 so that by the year 2030, there would be 1,324,000 annual recreation user-days available. The increase of 1,104,000 recreation user-days over future without-project conditions would represent an average annual net worth increase of $18,052,000. The reasons for these increases would be the same as those discussed under the EQ plan. The impacts of the recreational development plan would be identical to those discussed under the NED plan.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.297 These impacts would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.298 Maintenance of existing features would have only a minor impact on recreation. The conversion of forest to the pioneer early successional type due to disposal of dredged material would slightly decrease the available supply for hunting and wildlife-oriented recreation. Boat and barge traffic due to operation of navigable waterways would create a hazard to recreational users of these areas.

6.299 Since it is most likely that the floodway system would be operated in the spring, actual operation could adversely affect turkey hunting. Deer, turkey, quail, squirrels and rabbits lost in the flood would decrease the quality of the following hunting season. It was estimated that the 1973 flood caused a loss of 7,050 days of hunting on three management areas in the Red River backwater area (US Army Corps of Engineers, 1973). Fishing is disrupted during flooding due to swift currents and turbidity. The same study estimated a 1,500

user-day loss of fishing in these wildlife management areas. In the Atchafalaya Basin floodway, fishing was reported to have declined about 90 percent during the flood; however, post-flood fishing was greatly improved. This improvement was due to increased fish numbers and to the opening of previously unaccessible areas due to flushing by the floodwaters. Crawfishing activity was high during the flood, increasing about 50 percent above normal. It has been estimated that the net loss in fishing due to the 1973 flood was 55 percent. Similar impacts would be expected to occur each time the floodway system is used but they would be of a greater magnitude under Plan 4 (EQ) and Plan 9 (R) conditions since these plans would protect the resource base upon which recreational activities are founded.

WILDLIFE REFUGES AND MANAGEMENT AREAS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.300 Plan 4 would increase the public use of the two state wildlife management areas within the lower floodway and Atchafalaya Bay. The recreation features of this plan would enable many more people to visit these areas than would be possible under future without-project conditions. On the other hand, certain construction features of this plan would have adverse impacts upon these areas. Channel training of the Atchafalaya River main channel would destroy or alter small portions of the Attakapas Wildlife Management Area from river miles 90 to 95 (Plate 6), and the management unit feature would hinder boat access into the Buffalo Cove portion of the area due to channel closures and weir construction (Plate 1).

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.301 Operation and maintenance of proposed features would have a minor adverse impact on Attakapas Wildlife Management Area. Maintenance of the boat rollovers would preserve small boat access into the area.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.302 Plan 7 would also increase public use of the two management areas due to its features for recreational development. This plan would, however, cause additional disruptions due to possible construction of the entire Avoca Island levee through the center of the developing delta, which comprises the Atchafalaya Bay Wildlife

Management Area. The levee would reduce delta development and thereby reduce the overall size of the marsh areas making up the management areas. Thus, future users would have fewer acres to utilize. The presence of the Avoca Island levee would also have adverse esthetic impacts. If only Reach 1 were built, there would be no impact on the delta.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.303 Impacts due to operation and maintenance would be similar to those of Plan 4. Impacts of mitigation measures would be the same as those discussed for recreation resources.

Plan 9 (R)

6.304 The impacts of Plan 9 on existing wildlife management areas would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.305 Maintenance of existing features would have a positive impact on Three Rivers Wildlife Management Area. By preventing erosion in the Old River control structure outflow channel, the Three Rivers lands would be protected.

6.306 Operation of the floodway system would have a beneficial impact on the Atchafalaya Delta Wildlife Management Area by rapidly increasing the amount of valuable marsh habitat. Floodway operation would tend to fill lakes in the Attakapas area and cause the loss of cypress-tupelo habitat. On the other hand, it could alter the process of succession in bottomland hardwoods by elevating the land and allowing desirable species more adapted to dry sites to grow.

TIMBER

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.307 With this plan, there would be a slight overall decrease in timber resources in the project-affected area in the future (see section on forest habitat types for acreage changes that would affect timber resources). Within the lower floodway proper, however, an increase would occur due to the nondevelopment easement feature of this plan coupled with plant successional changes. Net income from timber production would decrease from about $5,960,000 in 1980 to

about $5,458,000 in 2030. The 2030 net income figure is, however, about $1,096,000 higher than would be the case under future without-project conditions. Additional information on the impacts of this plan or timber resources may be found in the sections on bottomland hardwood forests and cypress-tupelo swamps.

6.308 During the second half of project life, timber resources would probably increase in quality and value as the lower floodway continued to become drier in the north and plant succession led to improved stand composition in the bottomland hardwood areas. This would be in marked contrast to future without-project conditions where most bottomland hardwood forests in the northern portion of the lower floodway would be cleared for agricultural use. On the other hand, logging of cypress in the southern floodway could lead to decreases in timber resources similar to those that would occur under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.309 Policing of the easement lands would prevent unauthorized clearing of forests, which would preserve the timber resource. No impacts due to mitigation measures would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.310 With Plan 7, about half of the timber resources of the project-affected area would be lost by 2030 due to land clearing in both the Lower Atchafalaya Basin Floodway and in the backwater area northeast of Morgan City. This is slightly more than would be the case under future without-project conditions (see sections on forest habitat types for acreage changes affecting timber resources). Net income from timber production would decrease from about $5,960,000 in 1982 to about $4,148,000 in 2030. This represents an additional decrease of about $214,000 more than would occur under future without-project conditions in the year 2036. (Additional information about impacts of this plan on timber resources may be found in the sections on bottomland hardwood forests and cypress-tupelo swamps).

6.311 Continued loss of timber resources would occur during the second half of project life due to further land clearing. The magnitude of these losses would be about equal to what would occur under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.312 Operation and maintenance of proposed project features would have little impact on timber. Purchase of 16,800 acres of bottomland hardwood forest and the building of Buffalo Cove management unit would preserve timber resources that might otherwise be lost due to land clearing.

Plan 9 (R)

6.313 The impacts of this plan would be similar to those of Plan 4; however, there would be no prohibition of timber harvest on 20,000 acres of cypress-tupelo forest as there could be with Plan 4. Net income from timber production would, however, be slightly less in 2030 than under Plan 4 conditions. This difference would amount to about $17,000.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.314 The maintenance of existing features would have an adverse impact on about 5,000 forested acres. Disposal of dredged material on these areas would destroy existing trees and regular disposal would prevent growth of marketable timber.

6.315 It is unlikely that timber resources would be heavily damaged by operation of the floodway. Few substantial losses were reported due to the 1973 opening of the Morganza Floodway. As discussed under forest types, some seedlings, saplings and trees would be lost due to sedimentation and scouring, but growth of others would be benefited by the flood-carried nutrients. Estimated losses of timber in the 1973 flood were $500,000 (US Army Corps of Engineers, 1974). Substantial losses would occur in the timber industry due to curtailment or reduction of operations caused by high waters. Estimated losses in the 1973 flood due to such causes were $5.7 million.

OIL, GAS, AND MINERALS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.316 Flood control easements and the construction of management units might create situations where oil and gas exploration would be inconvenienced. With construction of management units, situations could develop where dredging of access or pipeline canals would disrupt the functioning of the management unit by interrupting water circulation patterns, unless special steps are taken. For example,

dredged material from the access canal might have to be deposited in a manner that would not restrict or disrupt the water flow, thus preserving the hydrological integrity of the management unit. The frequency and magnitude of these impacts are presently unknown; however, the potential for significant impacts would exist. Such impacts would not occur under future without-project conditions.

6.317 If oil and gas extraction is still occurring in the second half of project life, then it could be affected as described above.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.318 Operation and maintenance of proposed project features would have a minor beneficial impact on the oil and gas industry. By keeping the main channel from severely eroding and crevassing, oil and gas installations would be protected.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.319 With this plan, minor impacts to oil, gas, and mineral exploration could occur due to the nondevelopment flood control easement feature.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.320 Operation and maintenance impacts would be the same as for Plan 4. Building Buffalo Cove management unit could inconvenience oil and gas exploration and extraction.

Plan 9 (R)

6.321 Impacts would be the same as for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.322 Maintenance of existing features would have a positive impact on oil and gas interests by keeping navigable waterways open for crew boats and barges. The maintenance of locks would allow their continued use by mineral related industries.

6.323 Operation of the floodway system during major floods would cause substantial damages to the petroleum and natural gas industries within the basin. All oil and gas fields in the basin would suffer losses with production dropping by 60-90 percent (US Army Corps of Engineers, 1974). Besides production losses, damages to physical equipment facilities would occur.

CULTURE OF THE BASIN

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.324 The increased flooding in the backwater area northeast of Morgan City could lead to disruption of communities and displacement of commercial fishermen and other swamp users currently residing on natural levees. The nondevelopment flood control and environmental easements and the management units under this plan would serve to enhance the natural resources upon which the economy of the basin's folk culture is based. When compared to future without-project conditions, implementation of this plan would lessen the sedimentation rate and restrict land clearing in the lower floodway. This would slow the deterioration of the natural conditions, which have traditionally supported the economy of the basin's inhabitants. However, the greatly increased recreational use of the Lower Atchafalaya Basin Floodway, resulting from expanded public access and recreational development, would bring recreationists into conflict with existing commercial use of the floodway. The disruption of existing access routes and the limited access, which would be provided by the management units, would affect the traditional utilization of the basin's resources and cause competition over limited access facilties. The ongoing levee enlargement would continue to displace people in the Henderson Lake and Catahoula areas (Plate 5).

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.325 Operation and maintenance of proposed project features would generally have a beneficial impact on the culture of the basin by maintaining features which serve to preserve and enhance natural swamp productivity. The effects of the policing of easements on the culture of the basin would be decided by the relative allocation of swamp resources to recreational use versus the established commercial use of these resources.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.326 The siltation and clearing for conversion to agriculture of thousands of acres of presently forested land in the floodway and backwater area would have detrimental and far-reaching effects upon the folk culture of the project-affected area. The loss of this natural habitat would result in a concurrent decline in the quantity and quality of the resources available for utilization by the area's inhabitants. Traditional occupations would necessarily be abandoned in favor of employment in the petroleum and other industries.

Folk traditions, adaptive skills, and crafts would be lost in a relatively short time. This plan would allow more clearing than would occur under future without-project conditions and would, therefore, be more detrimental to the folk culture. The increased recreational use of the lower floodway above the base and future without-project conditions would lead to conflicts between the recreationists and the traditional commercial fishermen over the dwindling resource base. Therefore, the deterioration of the resource base and the increased competition from recreational users would adversely and irrevocably impact the folk culture existing in the project-affected area.

6.327 During the second half of project life, swamp productivity would continue to deteriorate, thereby further disrupting the traditional folk culture.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.328 Operation and maintenance of proposed features would have no impact on the culture of the basin. Acquisition of 16,800 acres of bottomland hardwoods and implementation of the Buffalo Cove management unit would generally have a beneficial impact. However, increased recreational use and the limited access provided to the management unit would adversely affect culture of the basin.

Plan 9 (R)

6.329 The impacts of this plan would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.330 Maintenance of existing features would have a beneficial impact on the culture of the project-affected area. Continued maintenance dredging would keep navigation open for commercial fishing vessels.

6.331 Operation of the floodway system would have long-term beneficial impacts on the culture of the basin due to the subsequent increase in fishery productivity. The short-term effects would be mixed, as fishing success during a flood greatly decreases and crawfishing yield increases significantly.

NATIONAL TRUST PROPERTIES

6.332 There are no National Trust properties in the project-affected area.

NATIONAL REGISTER PROPERTIES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.333 The draft report on the findings of the cultural resources survey of the East and West Atchafalaya Protection levees identified 12 cultural resources in the survey corridor as significant and eligible for inclusion in the National Register, including the two National Register-eligible properties in the project-affected area. Because the Avoca Island Pumping Plant Number 1, 16SMY52 is located in the potential environmental impact area of the project, a determination of eligibility was requested from the Keeper of the National Register pursuant to Title 36CFR Part 800. The resource was determined eligible on 14 September 1981 and a determination of no effect was executed on 14 September 1981 after minor alteration of the project design to avoid any impacts on the property. Four of the 12 significant resources (16SMY104, 16SMY107, 16AV33, and 16AV35), although located in the survey corridor, would not be affected by the project and therefore no further action is planned. For the remaining seven significant resources (16IV4, 16SM75, 16SMY130, 16SMY66, 16SMY2, 16SM50, and Register-eligible 16SM45) precise construction limits have not yet been determined. As project design continues, a determination of eligibility will be requested and the compliance procedures outlined in Title 36CFR Part 800 would be initiated for each of these resources located in the potential impact area of the project. Both Plan 4 and the future without-project condition include the levee raising feature. Thus, with both conditions, the ongoing levee enlargements would possibly affect one National Register property in the project-affected area, 16SM45, and six of the sites identified by cultural resources survey as potentially eligible for inclusion in the National Register. The full impact of other features of Plan 4 upon National Register properties cannot be addressed without the benefit of an intensive cultural resources survey of all areas to be affected by project features. Such a survey would be conducted for all features of the plan during the next stage of planning.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.334 Impacts of operation and maintenance of proposed project features and mitigation measures cannot be determined until cultural resources surveys of all the project features are completed. Upon completion of the cultural resources surveys, sufficient information would be available to avoid or protect significant cultural resources determined eligible for inclusion in the National Register, or, in the absence of a feasible alternative, mitigate any adverse effects by data recovery.

Plans 7 and 9 (NED and R)

6.335 The impacts of these plans would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.336 Maintenance of existing features would not have an adverse impact on any cultural resources currently listed in or determined eligible for inclusion in the National Register. Upon completion of the cultural resources survey of all project features, sufficient data would be available to avoid or protect significant sites, or, in the absence of a feasible alternative, mitigate any adverse effects by data recovery.

6.337 Operation of the floodway system could adversely impact sites eligible for the register by eroding them or covering them with sediment.

ARCHEOLOGICAL RESOURCES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.338 Since both Plan 4 and future without-project conditions include levee raising, these plans would have similar impacts on archeological resources and both would adversely affect numerous recorded sites. All other construction impacts of this plan must be measured against the zero construction impacts of future without-project conditions. Although the full impact of this plan cannot be determined due to an incomplete data base and the preliminary levels of design, the effects can be estimated based upon known site locations and prehistoric and historic settlement information. The land alteration related to recreation development and construction of other major project features would impact many recorded sites and undoubtedly more presently unrecorded sites. With this plan, urban development would occur mostly along the natural levees in the backwater area. Archeological sites now protected by their location in forestland along the edges of plowed fields would be affected by urban expansion.

6.339 The environmental easements of this plan would be beneficial to the conservation of archeological resources by regulating land clearing and excavation over all property in the lower floodway except some developed ridges. Although such an easement would protect cultural resources from unregulated land development, oil and gas

exploration would not be restricted, and these activities would continue to damage archeological resources. Additionally, public use of the 105,000 acres of public access lands under the real estate feature would subject archeological resources in these areas to vandalism and destructive artifact hunting.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.340 Operation and maintenance of proposed project features should not have an adverse impact on archeological resources. Upon completion of a cultural resources survey of all project features, sufficient information would be available to avoid or protect significant sites or, if required, to develop a mitigation plan.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.341 With this plan, the agricultural development that would occur in the project-affected area would result in adverse impacts to scores of archeological resources. Sites presently protected by their location in seasonally flooded areas would be impacted by agricultural expansion. The increased recreational use of the basin would subject archeological sites to vandalism and destructive artifact hunting. Additionally, construction related to major project features would impact numerous recorded sites.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.342 Purchase of 16,800 acres of bottomland hardwood forest and the building of Buffalo Cove management unit would protect any sites present in these areas.

Plan 9 (R)

6.343 The impacts of this plan would be similar to those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.344 The impacts of maintaining existing features cannot presently be determined as only a portion of the affected areas have been subject to cultural resources surveys. Upon completion of cultural resources survey of all project features, sufficient information would be available to avoid or protect significant sites, or, in the absence of a feasible alternative, mitigate any adverse impacts by data recovery.

6.345 Operation of the floodway system would adversely impact archeological sites by erosion and sedimentation.

NATIONAL REGISTRY OF NATURAL LANDMARK SITES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.346 Plan 4 would preserve large amounts of habitat in the natural state. This would allow the Registry to include the maximum amount of land if the final evaluation indicates the Lower Atchafalaya Basin Floodway or portions thereof are a significant landmark. The environmental easement would also allow flexibility in choosing lands, since the decision makers prefer to list lands already under some governmental protection.

6.347 If the lower basin is not chosen as a national landmark during the next 50 years, Plan 4 should preserve enough natural areas to allow it to be considered as a landmark in the future.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.348 Operation and maintenance of proposed project features would have a positive impact on a potential national landmark. Policing of the easements would preserve the timber and prevent illegal land clearing.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.349 Plan 7 would preserve less land in the natural state than Plans 4 or 9. Thus, the amount of land available for consideration as a natural landmark would be less with this plan. Also, most of the lower basin would remain in private ownership, which might further discourage any designation as a national landmark.

6.350 In the second half of project life, the additional land clearing below I-10 that would occur would limit availability for consideration.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.351 Mitigation measures and operation and maintenance of proposed project features would have no impact on a potential national landmark.

Plan 9 (R)

6.352 Impacts would be similar to those discussed under Plan 4, since this plan would also preserve large amounts of the lower floodway in a natural condition.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.353 Operation and maintenance of existing features would have no impact on any potential national landmark.

OPEN SPACE

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.354 This plan would provide for preservation of much of the existing open space within the project area, which would be lost under future without-project conditions.

6.355 During the 2030-2080 period, the open space protected by Plan 4 would become even more valuable as development surrounded the floodway.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.356 Policing of easements would prevent illegal clearing and preserve the naturalness of the area.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.357 This plan would stimulate the elimination of much of the open space in both the lower floodway and in the backwater area northeast of Morgan City. Loss of open space of a similar magnitude would also occur under future without-project conditions within the floodway but not within the backwater area.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.358 Impacts would be the same as for Plan 4. However, the real estate feature would be minimal and it is unlikely that policing to prevent clearing would be necessary.

6.359 Purchase of 16,800 acres of bottomland hardwood forest and building of Buffalo Cove management unit would preserve the existing open space of these areas.

Plan 9 (R)

6.360 This plan would have similar impacts upon open space as would Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.361 Maintenance of existing features would have a minor adverse impact on open spaces. Disposal of dredged material would destroy some existing forest.

6.362 Operation of the system as a floodway would have no impact on open space.

AIR QUALITY

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.363 Emissions from machinery and dust created during construction would slightly degrade air quality during the first decade of project life. This impact would be minor and temporary. Compared to future without-project conditions, this plan would prevent land clearing. Thus, the air pollution caused by burning of cleared timber and emissions from farm machinery would be prevented.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.364 Emissions from and dust caused by equipment utilized for maintenance of proposed features would cause a slight, temporary degradation in air quality.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.365 Direct construction impacts would be similar to those of Plan 4. However, the conversion to agriculture that would occur with this plan would be even greater than under future without-project conditions. Thus, the air pollution associated with clearing and farming would be increased over future without-project conditions.

Air quality in the Morgan City area would be degraded due to expansion of industrial activity made possible by extension of the Avoca Island levee.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.366 These impacts would be similar to those of Plan 4.

Plan 9 (R)

6.367 Impacts of this plan would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.368 Impacts would be similar to the operation and maintenance impacts of proposed features described for Plan 4.

ESTHETIC VALUES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.369 With Plan 4 in effect, esthetic values within the project-affected area would continue to decline due to the process of sedimentation and to the activities of the oil and gas industry. Harvesting of timber in the cypress-tupelo swamps would also cause a loss in esthetic values. These adverse changes would also occur under future without-project conditions. Certain project features, such as raising the east and west protection levees, would permanently degrade esthetic values, especially where sheet-piling construction is used. Other project construction would cause a short-term decrease in esthetic values early in project life. On the other hand, environmental easements of this plan would greatly enhance esthetic values by preserving the vast bottomland hardwood forest of the area. Overall, Plan 4 would greatly benefit esthetic values when compared to what would occur under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.370 Operation and maintenance of proposed project features would have a beneficial impact on esthetic values. Policing of the easements would protect existing forestlands from illegal clearing.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.371 This plan would bring about even greater degradation of esthetic values within the lower floodway and Atchafalaya Bay than would occur under future without-project conditions. Increased agricultural development within the floodway and the construction of the Avoca Island levee through the center of the developing delta would be the primary reason for this. Construction impacts would be similar to those of Plan 4.

6.372 Continued degradation of esthetic values would occur during the second half of project life due to continued development of the lower floodway.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.373 Operation and maintenance of proposed project features would have no impact on esthetic values. Mitigation measures would bring about gains in esthetic values due to preservation of 16,800 acres of bottomland hardwood forest and the building of Buffalo Cove management unit.

Plan 9 (R)

6.374 The impacts of Plan 9 would be similar to those of Plan 4. However, channel training of the Lower Atchafalaya River and Wax Lake Outlet would slightly increase losses to esthetic values and the real estate features of this plan would not preserve the esthetic values of cypress-tupelo swamp and bottomland hardwood forests as well as would Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.375 Maintenance of existing features would have an adverse impact on esthetics in the basin. The trees killed during maintenance dredging as well as the dredges and noise would decrease esthetic values. By permitting the continuance of barge traffic, maintenance would decrease esthetics.

6.376 Operation of the floodway system would have only minor impacts on esthetic values of the floodway. It is probable that people would visit the area to watch the flow of floodwaters.

UNDEVELOPED LAND

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.377 With this plan, most of the undeveloped land within the project affected area that could be developed under future without-project conditions would remain undeveloped due to the flood control and environmental easement feature of the plan or due to the rising water levels in the backwater area northeast of Morgan City.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.378 Operation and maintenance of proposed features would have a positive impact on undeveloped land. Policing of easements would prevent illegal clearing.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.379 With this plan, much of the undeveloped land within the lower floodway would be developed for agriculture and in the backwater area northeast of Morgan City; such land would eventually be developed for agriculture, industry, or housing. Under future without-project conditions, much of this development could not occur in the backwater area, but could occur within the floodway.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.380 Operation and maintenance of proposed features would have no impact on undeveloped land. Building Buffalo Cove managment unit and the purchase of 16,800 acres of bottomland hardwood forest would maintain these areas in an undeveloped state.

Plan 9 (R)

6.381 The impacts of this plan would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.382 Operation and maintenance of existing features would have no impact on undeveloped land.

PROPERTY OWNERSHIP

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.383 In addition to the land requirements necessary for construction, this plan would affect property ownership in the lower floodway through the easements and fee acquisitions that are part of the plan. It has not been precisely determined at this time how these acquisitions would affect the existing pattern of property ownership because the exact location of some specific easements have yet to be pinpointed.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.384 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.385 This plan would impact property ownership as a result of the land requirements necessary for construction. It would also impact the lower floodway as a result of easement and fee acquisition but to a lesser extent than Plans 4 and 9, since real estate features are limited to acquisition of nondevelopmental easements plus a small amount of fee land for recreational development features.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.386 Impacts due to purchase of 16,800 acres of bottomland hardwood forest for mitigation would occur.

Plan 9 (R)

6.387 The impacts of this plan would be the same as those of Plan 4 except that fee purchase from willing sellers would replace the public access and timber ownership easements.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.388 Operation and maintenance of existing features would have no impact on property ownership.

Section 122 Items

NOISE

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.389 This plan would increase noise levels within the lower floodway and in the area south of Morgan City during the initial construction phase of the project. Following completion of initial construction, noise levels in the southernmost parts of the project-affected area would continue to be higher than under future without-project conditions due to the increased recreational use of the area that would occur with this plan. In the northern parts of the floodway, noise levels would probably be lower than under future without-project conditions, since the future without-project condition includes the noise associated with agricultural development.

6.390 From 2030 to 2080, noise levels would continue to be higher than under future without-project conditions in the south and lower in the north.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.391 Operation and maintenance of proposed project features would cause a minor increase in noise levels due to operation of equipment necessary to maintain project features.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.392 Plan 7 would significantly increase noise above future without-project conditions levels. This would be brought about by initial project construction as well as by the increased recreational usage and industrial and agricultural development that would follow the construction phase of this plan.

6.393 Continuing expansion of agricultural and industrial development during the 2030-2080 period could continue to increase noise above future without-project levels.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.394 Impacts would be the same as for Plan 4.

Plan 9 (R)

6.395 Noise levels with this plan would not differ significantly from those of Plan 4, except during the initial construction phase when they would be slightly higher in the areas south of Morgan City due to the dredging activities associated with channel training the Lower Atchafalaya River and Wax Lake Outlet.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.396 Maintenance of existing features would have a minor adverse impact with regard to noise. The dredges and other equipment necessary to maintain various control structures, locks, etc., would increase noise levels as would machinery used to mow levees and grounds around structures.

6.397 Operation of the floodway system would not significantly increase noise levels.

DISPLACEMENT OF PEOPLE

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.398 This plan would cause considerable displacement of people, with consequent relocations. This would occur primarily due to the raising of the east and west guide levees (Plate 5) during the first part of project life. This work would impact hundreds of additional structures located primarily in the Henderson Lake and Courtableau areas. (Similar impacts would occur under future without-project conditions.) Many of these structures are residential and would require relocation. Additional displacement of people could occur due to realinement of distributary channels (Plate 7) and to widening the Wax Lake Outlet overbank area (Plate 9). It should be noted that this plan would not prevent the displacement and relocation of people in the backwater area northeast of Morgan City, which could occur under future without-project conditions due to rising water levels in that area. Several thousand people could be harmed by the water level increases, which would occur.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.399 No impacts would occur.

Plan 7 (NED)

6.400 The impacts of this plan would be the same as those of Plan 4 except that extension of the Avoca Island levee would prevent displacement of some people in the backwater area northeast of Morgan City.

Plan 9 (R)

6.401 The impacts of this plan would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.402 Maintenance of existing features would cause no displacement of people.

6.403 Operation of the floodway system would cause displacement of people from camps in the interior of the basin. Temporary displacement of people could also occur in the Upper Pointe Coupee Loop area, Krotz Springs, Melville, Butte La Rose, and Morgan City.

COMMUNITY COHESION

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.404 Under future without-project conditions, the lower floodway would become drier and extensive conversion of forestland to agricultural land would occur. These changes would make it more difficult to preserve traditional lifestyles in the area, causing a shift from employment in fishing and trapping to such activities as oil and gas production or agriculture. This plan would reduce the drying out process and subsequent agricultural development of the lower floodway compared to future without-project conditions and would result in less loss of fishing and trapping habitat. This would help to preserve the traditional lifestyle of the area. There are, however, other features of this plan that could unfavorably impact community cohension. Public access to large areas of the lower floodways, made available by the easements and recreation features of the plan, could create a conflict between commercial and sport fishermen. Expanded activities by sport fishermen could be viewed as encroachment into the "territorial claims" of commercial fishermen. Increased public access could also disrupt traditional patterns and habits of the many private hunting clubs in the lower floodway. Future rising water levels in the backwater area northeast of Morgan City would also tend to disrupt community cohesion.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.405 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.406 This plan's impacts would be essentially the same as under future without-project conditions, except that the Avoca Island levee would benefit community cohesion in the backwater area by preventing forced displacement of homes and businesses.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.407 No impacts would occur.

Plan 9 (R)

6.408 This plan's impacts would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.409 Maintenance of existing features would benefit community cohesion. Maintenance of intercepted and interior drainage would assure protection of people and property. Continued maintenance of the Old River complex would increase public trust in the structures.

6.410 Operation of the floodway system would not significantly impact community cohesion.

COMMUNITY GROWTH

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.411 The flood control and environmental easements of this plan would restrict community growth in the lower floodway.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.412 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.413 This plan would remove a potential hindrance to community growth in the backwater area by extending the Avoca Island levee. By preventing rising water levels, the area's growth potential would not be artificially impeded by an unacceptably high flood hazard.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.414 No significant impacts would occur.

Plan 9 (R)

6.415 The impacts of this plan would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.416 Operation and maintenance of existing features would have no significant impact on community growth.

LOCAL GOVERNMENT FINANCE, TAX REVENUES, AND PROPERTY VALUES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.417 The recreational development features of this plan would increase use of the lower floodway, thereby generating increase in sales and other taxes. On the other hand, the environmental easements of this plan would preclude agricultural expansion in the floodway and would prevent the generation of additional tax revenues above what would occur under future without-project conditions in that area.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.418 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.419 In the floodway area, there would be a significant change from future without-project conditions since the developmental control

easements of this plan would prevent expansion of urban or industrial development within the floodway. In the backwater area northeast of Morgan City, conversion of forestland to agricultural land and expansion of other forms of development could increase local property tax revenues.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.420 Purchase of 16,800 acres of bottomland hardwood forest as a mitigation measure would lower tax revenues by removing this land from the tax rolls.

Plan 9 (R)

6.421 The impacts of Plan 9 would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.422 Maintenance of existing features would have no impact on these factors.

6.423 The losses in agriculture, industry, and commerce that would occur due to operation of the floodway would cause a minor reduction in tax revenues and property value.

PUBLIC SERVICES AND FACILITIES

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.424 Increased visitation in the lower floodway resulting primarily from the recreational development feature of this plan would impact, to a minor degree, the public services and facilities of the area. The additional activity, for example, could necessitate a greater level of sanitation and law enforcement services.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.425 Operation and maintenance of proposed features would necessitate increased employment in the area of public services in order to manage the recreation facilities and the easement areas.

Plan 7 (NED)

6.426 The impacts of this plan would be similar to those of Plan 4.

Plan 9 (R)

6.427 The impacts would be the same as those discussed for Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.428 Maintenance of existing features would have no impact on public services and facilities.

6.429 Operation of the floodway system would cause substantial utility losses. In the Morgan City area it is likely that gas transmission lines would rupture, and telephone and electric service would be disrupted. Road and bridge damage would be substantial. During the 1973 flood, approximately $1,635,000 in losses were incurred by utilities (US Army Corps of Engineers, 1974). Similar losses could occur in the future. These losses would be greater under Plan 7 (NED) conditions than would be the case if the other plans were implemented.

BUSINESS AND INDUSTRIAL ACTIVITY AND REGIONAL GROWTH

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.430 The developmental control and environmental easement features of this plan would prevent further regional growth that could occur due to business, industrial, and agricultural expansion in the lower floodway.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.431 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.432 Within the lower floodway, developmental control easements would prevent business and industrial expansion but in the backwater area northeast of Morgan City, extension of the Avoca Island levee would encourage such expansion.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.433 No impacts would occur.

Plan 9 (R)

6.434 The impacts of this plan would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.435 Maintenance of existing features would have a positive impact on these activities. Dredging of navigation channels would allow continued use of waterways by business and industry.

6.436 Operation of the floodway system would adversely impact industrial and commercial developments located on the river side of the levee in Morgan City and Berwick and within the floodway south of Krotz Springs. In 1973, losses to such industries were $25,176,000, while commercial losses were $7,511,000. It should be remembered, however, that operation of the system would occur on the average of only once every 20 years.

EMPLOYMENT AND LABOR FORCE

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.437 With this plan there would be additional employment opportunities, of a minor degree of importance, generated by construction of the various structural features of this plan. There would also be additional employment opportunities resulting from the increased visitation generated by the recreational development features of this plan. In the backwater area, existing employment opportunities, could be lost due to abandonment of industrial and other commercial activities resulting under Plan 4 conditions. Within the lower floodway, the environmental easement and management unit features of this plan would help to maintain existing employment opportunities in commercial fishing and the timber industry, but would restrict potential opportunities in agriculture that could develop under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.438 Operation and maintenance of proposed project features would have a minor beneficial impact on employment because it would take numerous people to operate and maintain project features.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.439 In the floodway, conditions affecting employment and the labor force would be similar to those that would occur under future without-project conditions except that nonagricultural employment opportunities would be limited. In the backwater areas northeast of Morgan City, extension of the Avoca Island levee would help maintain existing employment opportunities which could be lost due to rising water levels under future without-project conditions.

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.440 Impacts would be the same as for Plan 4.

Plan 9 (R)

6.441 The impacts of Plan 9 would be the same as those of Plan 4.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.442 Operation of the floodway system would cause a temporary decrease in employment in the project-affected area because of flood caused interruptions, but an increase following the flood due to the need to repair and rebuild damaged structures.

DISPLACEMENT OF FARMS

Plan 4 (EQ)

Major Impacts of Proposed Project Features

6.443 This plan could allow approximately 10,000 acres currently used primarily for growing sugarcane to go out or production due to rising water levels in the future. (About 3,000 of these acres could eventually be protected by the proposed Terrebonne Parish Forced Drainage Project.)

Impacts of Mitigation Measures and Operation and Maintenance of Proposed Project Features

6.444 No impacts would occur.

Plan 7 (NED)

Major Impacts of Proposed Project Features

6.445 This plan incorporates the Avoca Island levee extension which would provide lower stages in the backwater area and would therefore help prevent about 10,000 acres of farmland from going out of production.

Plan 9 (R)

6.446 The impacts of this plan would be similar to those of Plan 4. This plan would, however, cause the loss of several thousand acres of existing farmland within the lower floodway, which would be purchased in fee for public access purposes.

Impacts of Operation and Maintenance of Existing Features (All Plans)

6.447 Maintenance of existing features would not displace any farms.

6.448 Operation of the floodway system would not permanently displace farms, but would temporarily disrupt production of all farms within the floodway system.

VECTORS

Plans 4 (EQ), 7 (NED), and 9 (R)

All Features

6.449 Deposition of dredged material has the potential to increase the breeding and development habitat for permanent water mosquitoes in confined disposal areas and habitat for temporary water breeders in unconfined areas and drying confined areas. Features such as channel training, sediment control, and widening Wax Lake Outlet overbank could also slightly increase mosquito potential. The district would incorporate into its plans measures to reduce mosquito breeding conditions to a minimum. Adult and larval pesticide spraying by local interests could become necessary.

7. LIST OF PREPARERS

The following people were primarily responsible for preparing this Environmental Impact Statement:

Name	Discipline/Expertise	Experience	Principal Role in Preparing EIS
Mr. Howard R. Bush	Recreation Resource Management/Outdoor Recreation Planning	5 years, Outdoor Recreation Planner, Department of Planning, State of Arkansas; 3 years, Outdoor Recreation Planner, New Orleans District	Effects on Recreation Resources/ Effects of Recreation Development Plan on the Environment
Mr. Eugene G. Buglewicz	Limnology	1 year, Water Quality Specialist, Department of Environmental Control, Nebraska; 5 years, Limnologist, Corps of Engineers, Walla Walla District; 3 years, Research Limnologist, Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi; 1 year, Environmental Studies, Corps of Engineers, Lower Mississppi Valley Division.	Preparation of 404(b)(1) Evaluations on Bank Stabilization and Maintenance Dredging
Mr. Nicholas G. Constan	Economics	12 years, Economic and Social Analysis Branch, New Orleans District	Economic and Social Impacts
Mr. Marvin A. Drake	Engineering/Environmental mental Engineering	12 years, Hydraulic and Environmental Engineer, New Orleans District	Effects on Water Quality
Mr. Donald M. Dunn[1/]	Civil Engineering/Water Resources Planning	2 years, Civil Engineer, Arkansas State Highway Department; 5 years, Civil Engineer, Memphis District, Corps of Engineers; 3 years, Civil Engineer, New Orleans District	Study Manager, Needs Assessment Plan Formulation Rationale, Effects on Flood-Carrying Capacity and Prime and Unique Farmlands Public Involvement
Miss Jessica Fox	Economics	2 years, Economist, Bureau of Labor Statistics, Atlanta and Philadelphia Regions; 8 months, Economist, New Orleans District	Socio-Economic Effects

Name	Discipline/Expertise	Experience	Principal Role in Preparing EIS
Mr. Paul J. Hanley[1/]	Economics	4 years economic studies, New Orleans District	Socio-Economic Effects
Mrs. Suzanne Hawes	Botany/Fisheries/Marsh Ecology	1 year Lab Associate, LSU Medical School; 10 years, Environmental Studies, New Orleans District	Effects on Fisheries and Marshes 404(b)(1) Evaluations
Mr. Jeffrey S. Heaton	Oceanography/Water Quality Specialist	2 years, Oceanographer, Naval Oceanographic Office, Bay St. Louis, MS; 1 year, Water Quality Section, New Orleans District	Effects on Water Quality
Mr. G. Gordon Hebert	Mechanical, Civil and Environmental Engineering/ Recreation Resource Management/Water Resources Planning	14 years, Project Engineering-Design and Construction Management for various manufacturing, construction, and consulting engineering firms; 6 years, Recreation-Resource Management and Water Resources Planning New Orleans District	Study Manager, Coordination and Preparation of Final Report
Mr. Theodore G. Hokkanen	Recreation Resource Management/Outdoor Recreation Planning	5.5 years, Chief Park Ranger, Pennsylvania Bureau of State Parks; 4 years, Chief Resource Ranger, Corps of Engineers, Vicksburg District; 2 years, Outdoor Recreation Planning New Orleans District	Effects on Recreation Resources/ Effects of Recreation Development Plan on the Environment
Mr. H. Tom Holland	Aquatic Biology	4 years, Fishery Research Biologist, US Fish and Wildlife Service; 1 year, Fishery Biologist, Corps of Engineers, St. Louis District; 4 years, District Biologist, Corps of Engineers, Jacksonville District; 9 years, Environmental Studies, Corps of Engineers, Lower Mississippi Valley Division	Section 404(b)(1) Evaluations on Channel Training (Atchafalaya River) and Maintenance Dredging
Miss June S. Holley	Secretary/Typist	7 months, New Orleans District; 3 years, US Army Reserve, New Orleans	Typing
Mr. Binford Johnson	Technical Publications/ writing/editing	9 years, Technical writer/editor, Boeing Company and Bell Aerospace; 10 years, managing and chief editor of trade publications, Chamber of Commerce of the Greater New Orleans area; 3.5 years, public information specialist with NO DRC and EPA. Kansas City, MO; 2 years, Technical publications/editor, New Orleans District	Editing and Coordination

Name	Discipline/Expertise	Experience	Principal Role in Preparing EIS
Ms. Elizabeth L. Johnson	Secretary/Typist	6 years, New Orleans District	Typing
Mr. Everett K. Johnson	Economics	30 years with Federal Government; 12 years, Chief Economist, New Orleans District	Review and Editing
Mr. Richard Manguno	Economics	5 years, Economic Studies, New Orleans District	Socio-Economic Effects
Mr. Gregory Martinez	Biology/Zoology/Fisheries	3 years Environmental Planning and Functions, Corps of Engineers, Nashville District; 5 months, Environmental Planning, New Orleans District	Effects on Fishery Resources 404(b)(1) Evaluation on Levees
Ms. Toni L. Massa	Secretary/Typist	7 years, New Orleans District	Typing
Dr. Tom Pullen, Jr.	Wildlife Biology/Ecology	5 years, Assistant Professor of Zoology, Auburn University; 2 years, Coordinator of Wildlife, Office of National Parks and Wildlife, El Salvador C.A.; 3 years planning and EIS studies, New Orleans District	EIS Coordinator, Effects on Terrestrial Habitat Types and Wildlife Resources
Mr. Oscar F. Rowe, Jr.	Mechanical and Civil Engineering/Water Resources Planning/Outdoor Recreation Planning and Resources Management	4 years, Mechanical Design, Air Force and Chrysler Corp.; 6 years, Mechnical, Civil, and General Engineering, Design, New Orleans District; 8 years, Civil Engineering Supervision, Operations, Maintenance, and Recreation and Resources Management, Planning and Design for New Orleans District's Dam and Lake Water Resource Projects; 2.3 years, Civil Engineering Supervision, Water Resources Planning, New Orleans District	Study Management Supervision, Coordination and Review, Preparation of draft and final reports.
Mr. James F. Roy[1/]	Planning/Civil Engineering, Water Resources	8 years, Civil Engineer (hydraulics); 25 years, Planner, Water Resources Studies and Reports; 5 years Chief Planner, New Orleans District	Management, Policy Directing and Review
Mr. Robert H. Schroeder, Jr.	Civil Engineering/Water Resources, Planning	3 years, Civil Engineering Consultant; 2 years, Construction Engineer, City of New Orleans; 18 years Civil Engineering, New Orleans District	Management, Supervision, Coordination and Review

Name	Discipline/Expertise	Experience	Principal Role in Preparing EIS
Mr. Daniel Smith[1/]	Engineering/Environmental Engineering	3 years, Environmental Engineer, New Orleans District	Effects on Water Quality
Mr. Michael E. Stout	Archeology/Cultural Resource Management	4 years, Corps of Engineers, New Orleans District	Effects on Cultural Resources
Mr. James E. Warren	Engineer/Environmental Engineer	3 years, Water Quality Section, New Orleans District	Effects on Water Quality
Mr. John C. Weber	General Biology/Zoology	3.5 years, Chemist, Texas Parks and and Wildlife Department; 10 years, Environmental Planning and Regulatory Functions, New Orleans District	Review and Editing

[1/] Formerly employed by New Orleans District.

8. PUBLIC INVOLVEMENT

8.1 This chapter describes the public involvement program to date and discusses how public views were incorporated into the study process. It includes the list of agencies, groups, and individuals, to whom the report/EIS was sent.

Public Involvement Program

8.2 This project has a long history of public involvement (as discussed in Section 1 of the main report). Prior to 1975, in the early stages of planning, 13 formal public meetings were held at various locations from Monroe to Morgan City to determine the desires of local interests. As a result, major requests were received for completion of the authorized flood control project and for preservation of fish, wildlife, and recreation resources. In 1972, a Steering Group, comprised of representatives from the National Wildlife Federation, the Louisiana Department of Public Works, the Louisiana Department of Wildlife and Fisheries, the US Department of the Interior, the US Environmental Protection Agency (US EPA), and the Louisiana State University, School of Environmental Design, was created to aid the US Army Corps of Engineers in EIS preparation. This group was active until 1976. A preliminary draft EIS, covering the previously authorized plan, was made public in November 1974, and a public meeting was held in January 1975. Concern was expressed that the plan was inadequate and would not protect Morgan City and other communities located at the lower end of the floodway system from flooding. Many people felt that the plan was lacking in methods to preserve environmental values in the floodway. In response, the Steering Group developed a multipurpose concept for the basin. Concurrently, in April 1974, an Agency Management Group, chaired by the US Army Corps of Engineers, and including the US EPA, the US Fish and Wildlife Service (US FWS), and the State of Louisiana, was formed to manage studies for development of a multipurpose plan for the basin. In 1976, studies of the authorized plan and preparation of an EIS were combined with Agency Management Group studies so that a comprehensive multipurpose plan for the basin could be developed. In late 1978, the Agency Management Group developed 10 multipurpose alternatives that were presented at a series of five public meetings in January 1979. These meetings attracted more than 5,000 people. Afterwards, approximately 25,000 comments centered on the primary focus of the meetings, which was a discussion of a plan developed by the US FWS to purchase the Lower Atchafalaya Basin Floodway. In 1980, representatives from environmental organizations, hunting clubs, the

oil and gas industry, the League of Women Voters, landowner organizations, sport fishing clubs, commercial fishing groups, agricultural interests, timber interests, and minority groups were invited and attended Agency Management Group meetings so that they could keep their constituents informed on the status of planning efforts. During 1979 and 1980, three meetings to review the status of the project were held in Washington, DC, with national level representatives of the Agency Management Group and other interested Federal agencies, national officers of environmental groups, and officials of the State of Louisiana.

8.3 In July 1981, five public meetings were held to discuss the tentatively selected plan, presented to the public in the draft report/EIS. These meetings attracted about 1,000 people, and about 4,000 written responses were subsequently received. Oral comments made during these meetings and the written comments received afterwards centered upon the proposed real estate feature of the tentatively selected plan.

Required Coordination

8.4 Circulation of the draft EIS accomplished the required coordination with the appropriate state, regional, and metropolitan Office of Management and Budget Circular A95 Clearinghouses, as provided under Executive Order 11988 (Floodplain Management); the Heritage Conservation and Recreation Service (HCRS) or their successor, and State Historic Preservation Officer, as provided under the National Historic Preservation Act; and the HCRS and National Park Service, as provided under the Federal Water Project Recreation Act. Circulation to the list of agencies, groups, and individuals mentioned in the following paragraph satisfied requirements of the National Environmental Policy Act. The participating state and Federal agencies and other interests such as landowners, hunting clubs, and the environmental groups are expected to continue an active role in this study.

Statement Recipients

8.5 All members of Congress and Federal and state agencies and environmental groups listed below were furnished copies of the draft main report/EIS (Volume 1). Each received Report Appendixes (Volumes 2, 3, and 4) that apply to their respective field(s) of expertise.

All others listed below received copies of Volume 1. For those interested in reviewing Volumes 2 through 4, but who were not mailed copies for review, copies were furnished the libraries listed below. The final report/EIS will be distributed to everyone on this list. In addition, each will receive a copy of the Public Views and Responses Appendix (Appendix J), which is Volume 4.

FEDERAL

J. Bennett Johnston, US Senator
Russell B. Long, US Senator
Corinne C. Boggs, US Congresswoman
John B. Breaux, US Congressman
Jerry Huckaby, US Congressman
Robert L. Livingston, US Congressman
Gillis W. Long, US Congressman
W. Henson Moore, US Congressman
William "Billy" Tauzin, US Congressman
Joe D. Waggoner, Jr., US Congressman
US Department of the Interior, Assistant Secretary for Program Development and Budget, Office of Environmental Project Review
US Fish and Wildlife Service, Regional Director, Atlanta, Georgia
US Fish and Wildlife Service, Area Manager, Jackson, Mississippi
US Fish and Wildlife Service, Field Supervisor, Vicksburg, Mississippi
US Fish and Wildlife Service, Field Supervisor, Bay St. Louis, Mississippi
US Fish and Wildlife Service, Field Supervisor, Lafayette, Louisiana
Environmental Protection Agency, Chief EIS Review Section, Region IV
Environmental Protection Agency, Regional Administrator, Region VI
Environmental Protection Agency, Administrator, Washington, DC
US Department of Commerce, Deputy Assistant Secretary for Environmental Affairs
US Department of Commerce, National Oceanic and Atmospheric Administration, Office of Ecology and Conservation
US Department of Commerce, Director, National Oceanic and Atmospheric Administration, National Ocean Survey
US Department of Commerce, Meterorologist in Charge, National Weather Service, New Orleans Area
US Department of Commerce, Regional Director, National Marine Fisheries Service
US Department of Commerce, Area Supervisor, National Marine Fisheries Service, Water Resources Division
US Department of Agriculture, Regional Forester, Forest Service
US Department of Agriculture, State Conservationist, Soil Conservation Service
US Department of Transportation, Division Engineer, Federal Highway Administration

FEDERAL (Continued)

US Department of Transportation, Commander, Eighth Coast Guard District

US Department of Health, Education, and Welfare, Regional Director, Public Health Service, Region VI

US Department of Health, Education, and Welfare, Water Resources Activity, Vector Biology and Control Division

Federal Energy Administration, Director, Environmental Impact Division, Office of Environmental Programs

Federal Power Commission, Acting Advisor on Environmental Quality, Washington, DC

Federal Maritime Commission, Office of Environmental Analysis

US Department of Housing and Urban Development, Regional Administrator, Region VI, Fort Worth, Texas

US Department of Housing and Urban Development Area Office, District, New Orleans, Lousiana

Advisory Council on Historic Preservation

STATE

Louisana Department of Health and Human Resources, Office of Health and Environmental Quality

Louisiana Department of Transportation and Development, Office of Public Works

Office of Intergovernmental Relations, Office of Governor

Louisiana Department of Highways, Public Hearings and Environmental Impact Engineer

Louisiana Department of Agriculture, Commissioner

Louisiana Department of Wildlife and Fisheries, Director

Louisiana Department of Wildlife and Fisheries, Oysters, Water Bottoms, and Seafoods Division, Chief

Louisiana Department of Wildlife and Fisheries, Game Division, Chief

Louisiana Department of Wildlife and Fisheries, Fish Division, Chief

Louisiana Department of Wildlife and Fisheries, Coordinator, Environmental Section

Louisiana Department of Wildlife and Fisheries, Monroe District Office No. 2

Louisiana Department of Wildlife and Fisheries, Alexandria District Office No. 3

Louisiana Department of Wildlife and Fisheries, Ferriday District Office No. 4

Louisiana Department of Wildlife and Fisheries, Opelousas District Office No. 6

Louisiana Department of Wildlife and Fisheries, Baton Rouge District Office No. 7

Louisiana Department of Wildlife and Fisheries, New Orleans District Office No. 8

STATE (Continued)

Louisiana State Parks and Recreation Commission
Louisiana Archaeological Survey and Antiquities Commission, State Archaeologist
Louisiana Office of Environmental Affiars
Louisiana Coastal Commission
Louisiana Public Service Commission
Louisiana Department of Natural Resources, Office of Forestry
Louisiana Department of Natural Resources, Office of Conservation
Louisiana Department of Natural Resources, Office of Environmental Affairs, Water Pollution Control Station
Louisiana Department of Commerce and Industry
Louisiana Department of Culture, Recreation, and Tourism, State Historic Preservation Officer
Louisiana Assistant Attorney General
Louisiana Department of Justice, Environmental Section
Louisiana Joint Legislative Committee on Environmental Quality, Louisiana Legislature
Louisiana State Land Office Register
Louisiana State Planning Office
Louisiana State Soil and Water Conservation Committee
Louisiana State University, Associate Director, Sea Grant Program, Center for Wetland Resources
Louisana State University, Coastal Studies Institute
Louisiana State University, Curator of Anthropology, Department of Geography and Anthropology
University of New Orleans, Coordinator, Environmental Impact Section, Department of Environmental Affairs
University of New Orleans, Department of Anthropology and Geography

ENVIRONMENTAL

Ecology Center of Louisiana, Inc.
Orleans Audubon Society, c/o Mr. Clifford Danby
Orleans Audubon Society, c/o Mr. Barry Kohl
National Audubon Society, Library
National Audubon Society, Southwestern Regional Office, Regional Representative
National Audubon Society, Field Research Director
National Audubon Society, Director of Audubon Sanctuaries
National Sierra Club, Thibodaux, LA
National Sierra Club, San Francisco, CA
Delta Chapter Sierra Club, New Orleans, LA
Baton Rouge Sierra Club
Chappepeela Group Sierra Club (Florida Parishes) Hammond, LA
National Wildlife Federation, Washington, DC
Louisiana Wildlife Federation, Baton Rouge, LA

ENVIRONMENTAL (Continued)

Louisiana Wildlife Federation, Water Control Projects Committee, Chairman, New Iberia, Louisiana
Wildlife Management Institute, Washington, DC
Wildlife Management Institute, South-Central Field Representative
The Conservation Foundation
Environmental Defense Fund
National Resources Defense Council
Environmental Information Center, Inc.
Trout Unlimited, San Antonio, Texas
Trout Unlimited, Sanford, Mississippi
League of Women Voters of US
Slidell Sportsmen's League
Louisiana Environmental Professional Association
South Louisiana Environmental Council, Houma, Louisiana
The Fund for Animals, Inc., Field Agent
St. Tammany Environmental Council

OTHERS

Terrebonne Parish Jury, Waterways and Permit Committee
Gulf States Marine Fisheries Commission

CLEARINGHOUSES

Northeast Regional Clearinghouse
Acadiana Regional Clearinghouse
Teche Regional Clearinghouse
Central Regional Clearinghouse
Lafayette Regional Planning Commission

LOUISIANA ACADEMIC LIBRARIES

Delgado Junio College
Dillard University
Louisiana State University at Alexandria
Louisiana State University Library
Louisiana State University in Eunice
Louisiana State University in Shreveport
Loyola University
Nicholls State University
Northeast Louisiana University
Northwestern State University
Southeastern State University
Southern University in New Orleans
Tulane University
University of New Orleans
University of Southwestern Louisiana
Xavier University

LOUISIANA SPECIAL LIBRARIES

Gulf South Research Institute
Huey P. Long Memorial Law Library
Louisiana Department of Commerce and Industry - Library
Louisiana Department of Public Works
Louisiana Department of Urban and Comminity Affairs
Louisiana State Planning Office

LOUISIANA PUBLIC LIBRARIES

Acadia Parish Library
Allen Parish Library
Ascension Parish Library
Assumption Parish Library
Audubon Regional Library
Avoyelles Parish Library
Beaureguard Parish Library
Bienville Parish Library
Bossier Parish Library
Shreve Memorial Library
Calcasieu Parish Public Library
Caldwell Parish Library
Cameron Parish Library
Catahoula Parish Library
Claiborne Parish Library
Concordia Parish Library
Concordia Parish Library
East Baton Rouge Parish Library
East Carroll Parish Library
Evangeline Parish Library
Franklin Parish Library
Grant Parish Library
Iberia Parish Library
Iberville Parish Library
Jackson Parish Library
Jefferson Parish Library Division
Jefferson Davis Parish Library
Lafayette Public Library
Lafourche Parish Library
LaSalle Parish Library
Lincoln Parish Library
Livingston Parish Library
Madison Parish Library
Morehouse Parish Library
Natchitoches Parish Library
Orleans Parish Library
Ouachita Parish Public Library
Plaquemines Parish Library
Pointe Coupee Parish Library

LOUISIANA PUBLIC LIBRARIES (Continued)

Rapides Parish Library
Red River Parish Library
Richland Parish Library
Sabine Parish Library
St. Bernard Parish Library
St. Charles Parish Library
St. James Parish Library
St. John the Baptist Parish Library
St. Martin Parish Library
St. Mary Parish Library
St. Tammany Parish Library
Tangipahoa Parish Library
Tensas Parish Library
Terrebonne Parish Library
Union Parish Library
Vermilion Parish Library
Vernon Parish Library
Washington Parish Library
Webster Parish Library
West Baton Rouge Parish Library
Winn Parish Library

CITY PUBLIC LIBRARIES

Jennings Public Library
Morgan City Public Library
Opelousas Eunice Public Library

INDIVIDUALS

Appendix J, Volume 4, contains a listing of all individuals who received the draft report/EIS.

Letters of Comment on the Draft EIS

8.6 Comments specifically pertaining to the draft EIS were received from the following:

FEDERAL

Advisory Council on Historic Preservation
Department of Agriculture, Forest Service
Department of Commerce, General Counsel
Department of Commerce, National Marine Fisheries Service

FEDERAL (Continued)

Department of Commerce, National Ocean Survey
Department of Health and Human Services, Public Health Service, Center for Disease Control
Department of Health and Human Services, Public Health Service, Regional Office IV
Department of Housing and Urban Development
Department of the Interior, Office of the Secretary
Department of Transportation, Federal highway Administration
Department of Transportation, US Coast Guard
Environmental Protection Agency
Gulf of Mexico Fisheries Management Council

STATE

Department of Natural Resources, Office of Environmental Affairs
Department of Natural Resources, Office of Forestry

LOCAL

Police Jury, Parish of Terrebonne
Sewerage and Water Board of New Orleans

ORGANIZATIONS AND BUSINESSES

Atchafalaya Land Corporation
Louisiana Land and Exploration Company
Mid-Continent Oil and Gas Association
Schiff, Hardin, and Waite
Tenneco Oil Exploration and Production
Texaco Incorporated
Wildlife Management Institute

INDIVIDUALS

D. S. Garden, Jr.
B. W. Hallmon

Public Views and Responses

8.7 The first part of this section discusses the public views that influenced the tentatively selected (TS) plan presented in the draft Feasibility Report/EIS and at the five July 1981 public meetings. The remaining portion presents opinions stated at those meetings, opinions addressed in letters commenting on the draft EIS,

and those expressed in about 4,000 letters included in the public record of the meetings.

VIEWS INFLUENCING THE TENTATIVELY SELECTED PLAN

8.8 Two major public views heavily influenced selection of the TS plan. These were concern about flood control and environmental issues. The public is profoundly concerned about flood control and desires a plan that will safely pass the project flood and protect southern Louisiana from Mississippi River flooding. Inhabitants of Morgan City, who live at the lower end of the floodway, have consistently stated that it is vitally important to increase the capacity of the outlets to allow floodwaters to reach the gulf without damaging Morgan City. People to the east and northeast of Morgan City desire protection from backwater flooding, a problem that will become increasingly severe in the future. All these views were incorporated into the decision-making process by providing channel training, levee raising, sediment control, increase in outlet capacity, widening of Wax Lake Outlet overbank, channel training below Morgan City, and construction of the 14,000-foot extension of the Avoca Island levee in the TS plan.

8.9 The other major concern has been expressed by the environmental community who desires preservation of fish and wildlife resources, public access into the Lower Atchafalaya Basin Floodway, and recreational facilities. Numerous features of the TS plan, such as nondevelopmental flood control easements, environmental easements that would prevent forest clearing throughout the entire Lower Atchafalaya Basin Floodway, public access to more than 105,000 acres of the Lower Atchafalaya Basin Floodway, boat-launch ramps, campgrounds, management units, and sediment control, addressed these concerns.

8.10 Another matter of major public concern was the independent proposal of the US FWS to purchase the Lower Atchafalaya Basin Floodway in fee. This proposal created a dispute of exceptional magnitude with the basin landowners and hunting club members opposing the environmental groups. After extensive study, the outcome was the above-described real estate interests of the TS plan.

8.11 Various interest groups have expressed a desire to vary operation of the Old River control structure slightly during May, June, and July. Farmers in the Red River backwater area would benefit some years from a reduction in flow into the Atchafalaya River so that stages would not rise above 45 feet at Acme. The US FWS would like to see flows increased some years in order to benefit fishery resources in the lower floodway. This concern was recognized in project planning and short-term changes in flow distribution were proposed

when such changes could be accomplished without adversely impacting other resource uses.

8.12 While maximizing public access was a study objective, it was a concern of the public that this objective is not altogether compatible with preservation of fish and wildlife resources and esthetics.

VIEWS EXPRESSED ON THE TS PLAN THAT INFLUENCED THE RECOMMENDED PLAN

Views expressed at the July 1981 public meetings.

Baton Rouge Meeting

8.13 The first meeting attracted 343 people of which 40 gave statements. The trend of the meeting was set quickly as half of the speakers were in favor of public access easements, especially greenbelts, and the other half opposed any expropriation of land for recreational purposes. Statements were made for and against management units, opposition was voiced about the Avoca Island levee extension, and other project features were mentioned, but the major subject of discussion was the real estate plan.

Morgan City Meeting

8.14 A meeting was held in Morgan City on 16 July, which had 241 people in attendance who presented 34 statements. This meeting centered on two underlying themes: real estate and the Avoca Island levee extension. The only support for the extension was voiced at this meeting located in the area affected by backwater flooding. Two local mayors and one state representative spoke in favor of quick completion of the levee while two officials from Terrebonne Parish and numerous individuals opposed the extension on environmental grounds. Several landowners voiced opposition to expropriation of private property and greenbelts and favored the Louisiana Landowners Association (LLA) real estate plan. A few members of the environmental community spoke in favor of the proposed multipurpose easement, including greenbelts.

Lafayette Meeting

8.15 This meeting was held on 20 July. Approximately 243 people attended and 54 presented statements. The speakers were nearly evenly divided between those opposing expropriation of private land, except for the LLA proposal, and those who favored the real estate plan

presented in the TS plan. Management units were also discussed, with some speakers expressing opposition and others favoring them.

Jonesville Meeting

8.16 This meeting, held 20 July, attracted 65 people and 13 statements were made. The major theme of most speakers at this meeting in the Red River backwater area was control of flows at the Old River control structure. Some individuals and groups, representing agricultural interests, were in favor of decreasing flows during May, June, and July to provide flooding relief to farmers of the affected area. Representatives of environmental groups favored maintenance of the existing 70/30 division of flows.

New Orleans Meeting

8.17 This last meeting on 22 July attracted the greatest number of speakers (77) while only 216 people were in attendance. Environmental interests were heavily represented and generally favored all elements of the TS plan except the Avoca Island levee extension and reduction of flows at Old River. Basin landowners were almost equally well represented and all were against expropriation of private property, especially for greenbelts. Most were in favor of the LLA plan. Management units also received some attention with environmental interests being in favor of them and a few landowners registering opposition.

8.18 In summary, the meetings attracted about 1,000 people and 218 made statements. Concerns over the real estate plan and extension of the Avoca Island levee were the major opinions expressed.

Views expressed in comments on the draft EIS (DEIS).

8.19 Twenty-six letters were received, specifically commenting on the DEIS. Most of this correspondence expressed opinions on the TS plan, while other letters expressed concern over data gaps in the DEIS. These comments are discussed below as they relate to each major feature of this plan.

Flows at the Old River control structure

8.20 The US FWS, US EPA and Mr. B. W. Hallmon requested that the Recommended Plan not include reduction of flows at Old River control structure to hold 45 feet at Acme, Louisiana, during May, June, and July in order to aid agricultural interests. They requested that flows be increased, when possible, to aid fishery interests in the basin. The Sewerage and Water Board of New Orleans requested that a minimum flow of 150,000 cubic feet per second be maintained at the Mississippi River passes, regardless of flows at Old River. Subsequent to the publication of the DEIS, further analysis was made

of the flow variation at Old River. If only a decrease in flows into the Atchafalaya occurred, there would be substantial environmental losses in the Red River Backwater area and in the Lower Atchafalaya Basin Floodway. Induced clearing of approximately 1,000 acres of bottomland hardwoods in the backwater area would occur. Fishery productivity in several areas would be significantly decreased for the following reasons: increased agricultural pollution and severely reduced water exchange in the backwater area; elimination of overbank flooding on 77,000 acres of forest and swamp in the floodway; and reduction of freshwater, sediment, and nutrient input into the Atchafalaya delta-Terrebonne marsh complex. On the other hand, it is not feasible from an engineering standpoint to increase flows significantly into the Atchafalaya River because this would enhance the possibility of capture of the Mississippi River by the Atchafalaya River. Thus, increasing flows is infeasible and decreasing flows is not only environmentally unacceptable, but only marginally necessary, since approximately half of the benefits that would be realized from decreasing flow would be generated in parts of the backwater area for which authorized ring levees are planned. Accordingly, this alternative was not included in the Recommended Plan. Instead, maintenance of the existing 70/30 annual distribution of flows is recommended.

Management units

8.21 The US FWS, US EPA, Wildlife Management Institute, and Mr. Hallmon requested that all 13 management units be implemented. Mr. Gardner was opposed to construction of any management units. Mid-Continent Oil and Gas Association was concerned about the lack of specific detail on management units and about their impact on the oil and gas industry. Texaco, Incorporated, felt that units would create access and operational problems. The US Coast Guard requested that consideration be given the input from oil companies, commercial fishermen, and recreational boaters prior to finalizing plans for units. These comments were noted and the Recommended Plan is considered the best proposal due to the uncertainty over impacts of the units. The New Orleans District would construct two pilot units, monitor and evaluate them in conjunction with cooperating agencies. Then the group would recommend possible funding for other units. Input from the oil and gas industry, fishermen, and boaters would also be considered. This procedure would not preclude eventual construction of all 13 units.

Avoca Island levee extension

8.22 The US FWS, US EPA, National Marine Fisheries Service, Gulf of Mexico Fisheries Management Council, Louisiana Land and Exploration Company, Wildlife Management Institute, and Mr. Hallmon all objected to inclusion of the Avoca Island levee extension in the Recommended Plan. Mr. Gardner was in favor of the levee extension. The opposition centered on potential loss of environmental values in the

Terrebonne Parish marshes and on uncertainty concerning potential impacts of the proposed extension. These concerns, coupled with reduced flooding projections caused by further investigating engineering data to consider the effect of widening of the Wax Lake Outlet overbank area and other project features, have led to a delay on implementing the extension of the levee and/or other structural and nonstructural measures until completion of additional detailed studies by 1985. A supplemental EIS would be prepared for this plan feature.

Delta development

8.23 The National Marine Fisheries Service, US FWS, US EPA, and Mr. Hallmon all desired commitment to a plan that would maximize delta formation in Atchafalaya Bay. They generally favored waiting until the delta model and delta management plans are completed before varying the percentage of flows at the outlets to the floodway. The Recommended Plan proposes that the present 70/30 distribution of flows be stabilized and that delta growth and marsh deterioration be monitored. By this time the delta model should be usable. If it were found necessary to further restrict flows to 80/20 and if desirable, sediment could be redistributed to Wax Lake Outlet at this point. On the other hand, if found environmentally beneficial, flows could be restricted to 80/20; then, due to engineering constraints, no increase in sediment transport to Wax Lake Outlet would be possible.

Sediment traps

8.24 The US FWS, US EPA, and Mr. Hallmon requested that further study be conducted on the use of sediment traps. Unfortunately, sediment traps would actually do little to reduce the amount of sediment entering the backswamps, since they would tend to fill with sand-sized particles which normally are deposited on existing natural overbank levees and not in the backswamps proper. These sands would need to be dredged annually, and over the life of the project, 3,000 acres of forestland would be destroyed from dredged material disposal. Thus, sediment traps were not included in the Recommended Plan. The US EPA claims significant sediment control benefits for management units. However, analysis indicated that such units would do little to reduce sedimentation in the basin.

Channel training below Morgan City

8.25 The US EPA and Mr. Hallmon stated that they opposed channel training below Morgan City claiming it was unnecessary. The US FWS reserved judgment on this matter. It was retained in the Recommended Plan because it provides the lowest flowline and, therefore, makes the levee raising feature less costly.

Real estate features

8.26 The real estate feature of the TS plan received a great deal of attention in the EIS review. The Atchafalaya Land Corporation opposed any real estate purchases in the basin for recreational interests. Mid-Continent Oil and Gas Association opposed any easement that controlled excavation and fill and wanted future access rights to be assured. Schiff, Hardin, and Waite were concerned about the impacts of the TS plan on a client's tree farm in St. Landry Parish. Texaco, Incorporated, was opposed to the greenbelts because of problems with liability, trespass, and upkeep. Mr. Gardner opposed expropriation of private lands for recreation, greenbelts, and any restrictions on land clearing. The US EPA supported the TS plan real estate feature. The US FWS was concerned that the TS plan would allow the Corps to set up a "permit" program, which would allow land use changes and that Section 404 of the Clean Water Act would not protect wetlands. They also opposed separation of benefits attributable to recreation and land use controls. Mr. Hallmon favored fee title purchase of 443,000 acres of basin lands.

8.27 Just prior to the public meetings, the Louisiana Landowners Association proposed to the state, an alternative for the public access part of the real estate feature that consisted of fee purchase of approximately 40,000 to 50,000 acres in the lower floodway from willing sellers, a 30,000-acre donation from Dow Chemical Company, and comprehensive multipurpose easements for flood control and environmental protection as was proposed in the TS plan. The state chose not to incorporate this proposal into their prior real estate recommendations, so it was not included in the TS plan.

8.28 Subsequent to the July 1981 public meetings, major interests (landowners, environmental groups, and the state) met and negotiated a new proposal for public access. The major considerations were the elimination of greenbelts and a recommendation to tighten provisions of the comprehensive multipurpose easement to prohibit land use conversion. The Dow land donation and purchase of 40,000 to 50,000 acres from willing sellers was also part of the new proposal. Governor Treen announced this new substitute recommendation at a press conference on 19 November 1981. Generally, this new proposal has been incorporated in the Recommended Plan.

Simultaneous implementation of features

8.29 Since most flood control features have been previously authorized, it is possible to proceed with implementation without further congressional approval. However, few of the environmental features are authorized and would need congressional authorization prior to construction. The US FWS, US EPA, and Mr. Hallmon requested that an effort be made to simultaneously implement the flood control and environmental features so that the entire plan would be kept

intact throughout authorization and funding. The validity of this concern was recognized, but it was considered unwise to allow the flood threat to southern Louisiana to continue any longer than necessary. The responsibility of the US Army Corps of Engineers is limited to recommending solutions to problems facing the Atchafalaya Basin; whereas, authorization for the plan features to be implemented, if any, is at the discretion of the US Congress.

Management entity

8.30 The US FWS, US EPA, and Mr. Hallmon all favored a state/Federal management entity to oversee the management of the basin. This entity was envisioned as including the US FWS and US EPA. The Recommended Plan calls for a management entity composed of the Corps of Engineers and appropriate state agencies. Since these agencies possess more than adequate expertise to manage all aspects of the basin, there would be little gained by involving other Federal agencies.

Other comments on DEIS

8.31 Other agencies and individuals had comments on the EIS which are summarized in this paragraph. The US FWS and Mr. Hallmon mentioned several other issues such as utilization of a true future without-project, period of analysis, operation and maintenance costs, and assessment of acceptability, which they felt were unresolved. The Advisory Council on Historic Preservation desired a formal request from the Corps for Council comment. The National Ocean Survey requested that they be notified of any activity that would disturb or destroy geodetic control survey movements. The National Weather Service requested that the areas of disagreement discussed by the US FWS and US EPA be investigated in greater detail. The Centers for Disease Control requested that the project features not increase vector populations and that the vector problem be addressed in the EIS. The Federal Highway Administration requested that allowances be made for upgrading and expanding the highway system in the basin, when necessary. The US Forest Service was apprehensive that clearcutting could be interpreted as conversion to other land uses and requested additional information on timber and the impacts thereon be included in the final EIS. The State of Louisiana Office of Forestry also requested that such data be included in the final EIS. They also stated that clearcutting is the best method of regenerating cypress and expressed a desire to perpetuate the present forested diversity in the floodway. These comments have been generally addressed in the final report/EIS.

Views expressed in letters contained in the public record of the July 1981 public meetings.

8.32 The distribution of the Draft Report/EIS and the July 1981 public meetings caused an outpouring of responses to various features of the TS plan. Many form letters were received and numerous individuals wrote personal letters expressing their concern about various project features. Some of these letters expressed views that caused a reevaluation on the TS plan and an alteration of certain features. The role that the letters played in the development of the Recommended Plan is described below.

Flood control features

8.33 An analysis of the correspondence indicated that nearly all respondents were in favor of flood control. Virtually no adverse mention was made of features such as levee raising, bank stabilization, or widening of the Wax Lake Outlet. Channel training above Morgan City was favorably mentioned a few times and had very little opposition. Numerous people saw distributary realinements as a positive method of flood control. Several letters suggested that sediment traps be reconsidered. For the reasons delineated in paragraph 8.24 above, this feature was not included in the Recommended Plan. Very few letters stated any opinion on the TS plan proposal for distribution of flows at the outlets to the floodway, but several people expressed the desire of encouraging natural delta formation. It is possible that the Recommended Plan could accommodate this view as indicated in paragraph 8.23 above.

Flows at the Old River control structure

8.34 Several letters and a petition stated opinions on the alternative to decrease the flows at Old River some years and to increase flows other years. Agricultural interests and landowners were generally in favor of the portion of the alternative that decreased flows during May, June, and July, while environmental interests favored the portion of the alternative that would increase flows down the Atchafalaya River. Other favored maintaining a strict 70/30 distribution. For the reasons discussed in paragraph 8.20 above, the Recommended Plan calls for a 70/30 annual distribution at Old River.

Management units

8.35 Management units received considerable attention in the correspondence. A few letters, mostly from affected landowners who were justifiably concerned about the possibility of damage to their timber, opposed management units. Numerous letters proposed that all 13 units be authorized and implemented. As described in paragraph

8.21 above, the original proposal in the TS plan would be the most responsible approach to take in implementing this feature.

Freshwater diversion structures and related features

8.36 Very few people expressed opposition to the authorized freshwater diversion structures. However, many residents and users of Bayou Courtableau opposed that bayou as the location for one of the structures. The New Orleans District subsequently studied alternative sites, met with local residents and cooperating agencies and tentatively identified Big Bayou Graw as a better site for the structure. The circulation improvements proposed in the TS plan received no opposition and were retained in the Recommended Plan.

Avoca Island levee extension

8.37 Numerous comments were received on the extension of the Avoca Island levee. Individuals, corporations, environmental groups, the Terrebonne Parish School Board, and the Terrebonne Parish Police Jury all expressed opposition to the extension while one corporation in the backwater area was in favor of the levee because they felt it would reduce flooding of their timber. For reasons delineated in paragraph 8.22 and elsewhere in the final EIS and appendixes, implementation of the backwater protection alternative has been delayed pending completion of additional studies.

Real estate features

8.38 The bulk of the comments on the TS plan concerned the real estate features. The comprehensive multipurpose easements for environmental and flood control purposes received wide support. On the other hand, numerous letters opposed any expropriation of private lands and favored private ownership. Many of these writers preferred the LLA plan. The specific real estate concept that drew the most opposition was greenbelts. They were opposed because individuals felt that they would take the higher ridge land from an owner, would increase poaching and trespassing onto adjacent land, would attract litter, and would leave the owner liable for personal injury suits. Environmental groups and others were in favor of the 1980 State of Louisiana plan and many expressly supported the greenbelt concept. As described in paragraphs 8.27 and 8.28, a new proposal that addresses many of the above concerns about greenbelts, expropriation, and public access has been negotiated by major interests, accepted by the State of Louisiana and is generally included in the Recommended Plan.

Timing of construction of plan features

8.39 Several letters were received concerning the timing of construction of various features of the TS plan. The environmental community expressed desire for simultaneous implementation because of

a fear that the flood control features would be built while the environmentally beneficial features may not be authorized by a budget-conscious US Congress.

CONCLUSIONS

8.40 The public views expressed on the TS plan have caused several changes to be made in the Recommended Plan. It is now recommended that the flow at Old River be maintained at the existing 70/30 annual basis, that a new public access plan, apparently favored by all interests, be included, and that implementation of further extension of the Avoca Island levee and/or other structural or nonstructural features associated with backwater flooding east of the lower floodway be delayed pending the completion of additional studies of the bay-marsh complex.

9. INDEX

(ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA)

SUBJECTS	ENVIRONMENTAL IMPACT STATEMENT	MAIN REPORT (References Incorporated)	REPORT APPENDIXES (References Incorporated)
Affected Environment	pp. EIS-73-102	pp. 15-29	App. A, pp. A-13 - A-195
Alternatives	pp. EIS-23-72	pp. 33-39	App. B, pp. B-10 - B-43; App. C, pp. C-29 - C-45
Aquatic Habitat Evaluation, Methodology and Analysis			App. G, pp. G-3 - G-18
Areas of Controversy	pp. EIS-8-10		
Atchafalaya Basin Floodway Project, Operation			App. A, pp. A-26 and A-27
Atchafalaya Basin Floodway Project, Principal Features	pp. EIS 23-29		App. A, pp. A-23 - A-25, A-27 - A-59
Benefit Calculations			App. D, pp. D-7 - D-56
Benefit Cost Analysis, Recreation			App. D, pp. D-63 - D-66; App. F, pp. F-69 - F-73
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RECOMMENDATIONS

1. The following features of the Atchafalaya Basin, Louisiana, project are authorized and have been approved by the Chief of Engineers and will continue to be implemented by the New Orleans District Engineer.

a. Continued operation of the Old River control complex and the new auxiliary structure to maintain an average annual latitude flow division at Old River, Louisiana, of 70 percent Mississippi River/30 percent Atchafalaya River;

b. Modification of existing features, where required, to pass the project flood, including raising to grade the East and West Atchafalaya Basin Protection Levees and the levees west of Berwick; construction of service roads on levee crowns; modifying Bayou Sorrel, Bayou Boeuf, and Berwick locks; modifying the Charenton and East Calumet floodgates; modifying the Wax Lake East and Wax Lake West drainage structures; modifying culverts in the East and West Bayou Sale levees; and modifying the Upper Pointe Coupee, Centerville, Ellerslie, Franklin and Franklin Enlargement, Gordy, Maryland, North Bend, Wax Lake East, Wax Lake West, Bayou Yokely and Bayou Yokely Enlargement, Morgan City, and Tiger Island pumping plants; and such other miscellaneous modifications as deemed appropriate; and

c. Continued construction of bank stabilization measures, as required, along the Atchafalaya River main channel above river mile 55.0.

2. It is recommended that the Chief of Engineers approve implementation of the following features of the Atchafalaya Basin project under existing authorization.

a. Enlargement of the main channel by construction of training works along the Atchafalaya River to a height sufficient to confine average annual peak flows, from river mile 116.0 to mile 90.0, and maintenance of existing channel banks from river mile 90.0 to mile 53.0 on the east side and mile 55.0 on the west side;

b. Realinement of the four principal distributaries of the Atchafalaya River main channel: the Old Atchafalaya River, the east freshwater distribution channel, the west access channel, and the east access channel to provide the optimum channel entrance angles for sediment control;

c. Construction of a rock weir and connecting levees above the head of Grand Lake to control the present distribution of low to

normal floodway outlet flows to approximately 30 percent through the Wax Lake Outlet and 70 percent through the Lower Atchafalaya River. For flows exceeding a 10-year frequency event, the low-level levees above Wax Lake Outlet would be overtopped. Operation of the outlet system will be monitored, and provided that the area's ecosystem responds favorably, then flow into Wax Lake Outlet may be further restricted by modification of the rock weir to limit low to normal flows entering the outlet to approach 20 percent;

d. Enlargement of Wax Lake Outlet overbank by setting back the existing west Wax Lake Outlet levee an average of about 3 miles and degrading the old levee to natural ground level and construction of a new West Calumet floodgate;

e. Enlargement of the outlet channels by construction of training works below Morgan City on both the Wax Lake Outlet and Lower Atchafalaya River and closure of Bayou Shaffer. Training works will simulate the formation of natural levees along about 15 miles of existing channel length by placing dredged material to a height sufficient to confine average annual peak flows, in an irregular series of low mounds about 1 vertical on 40 horizontal, with gaps in between;

f. Construction of further extensions of the East Atchafalaya Basin Protection Levee beyond the Avoca Island Cutoff channel and/or other structural and nonstructural measures, after completion of further studies of the engineering and biologic parameters affecting the complex, dynamic and delicate ecosystem of the Atchafalaya Bay-Terrebonne Marsh-backwater complex; and

g. Construction of freshwater distribution structures for the Henderson Lake and Alabama Bayou areas in the lower floodway. The Courtableau structure site will be relocated to a site in the vicinity of Bayou Graw near river mile 45.0 on the west Atchafalaya River levee, and the Sherburne structure will be located in the east river levee at approximate river mile 43.0.

3. It is recommended that the Atchafalaya Basin Feature of the Mississippi River and Tributaries Project, authorized by the Flood Control Act, approved 15 May 1928, as amended, be further modified and expanded to provide improvements as follows, with such modifications, substitutions, additions, or deletions as in the descretion of the Chief of Engineers may be advisable in the interest of flood control and environmental improvements.

a. Acquisition of additional real estate interests, excluding minerals, in the Lower Atchafalaya Basin Floodway for:

(1) Flood Control Purposes - Flowage easements on approximately 59,000 acres and developmental control easements on approximately 367,000 acres, excluding developed ridges.

(2) Environmental Protection Purposes - In addition to developmental control rights, environmental protection rights will be included in a comprehensive multipurpose easement on the same 367,000 acres, excluding developed ridges.

(3) Recreation Development Purposes - Fee simple title, excluding minerals, on 1,500 acres.

(4) Public Access - Participation with the State of Louisiana in the fee title purchase, excluding minerals, of approximately 50,000 acres of lands identified by the State as being available from "willing sellers." Federal cost participation will be limited to $32,000,000.00 (The State will provide additional public access within the lower floodway on 150,000 acres of existing State-owned lands and more than 30,000 acres of lands donated to the State by the Dow Chemical Company.);

b. Construction of recreation facilities to provide three destination-type campgrounds, seven primitive campgrounds, boat-launching ramps, and other facilities complementary to outdoor recreational activities;

c. Initial construction of two "pilot" Management Units, with implementation of future units to be dependent on operational success of the pilot units; and

d. Construction of miscellaneous canal closures and water circulation improvements in the lower floodway.

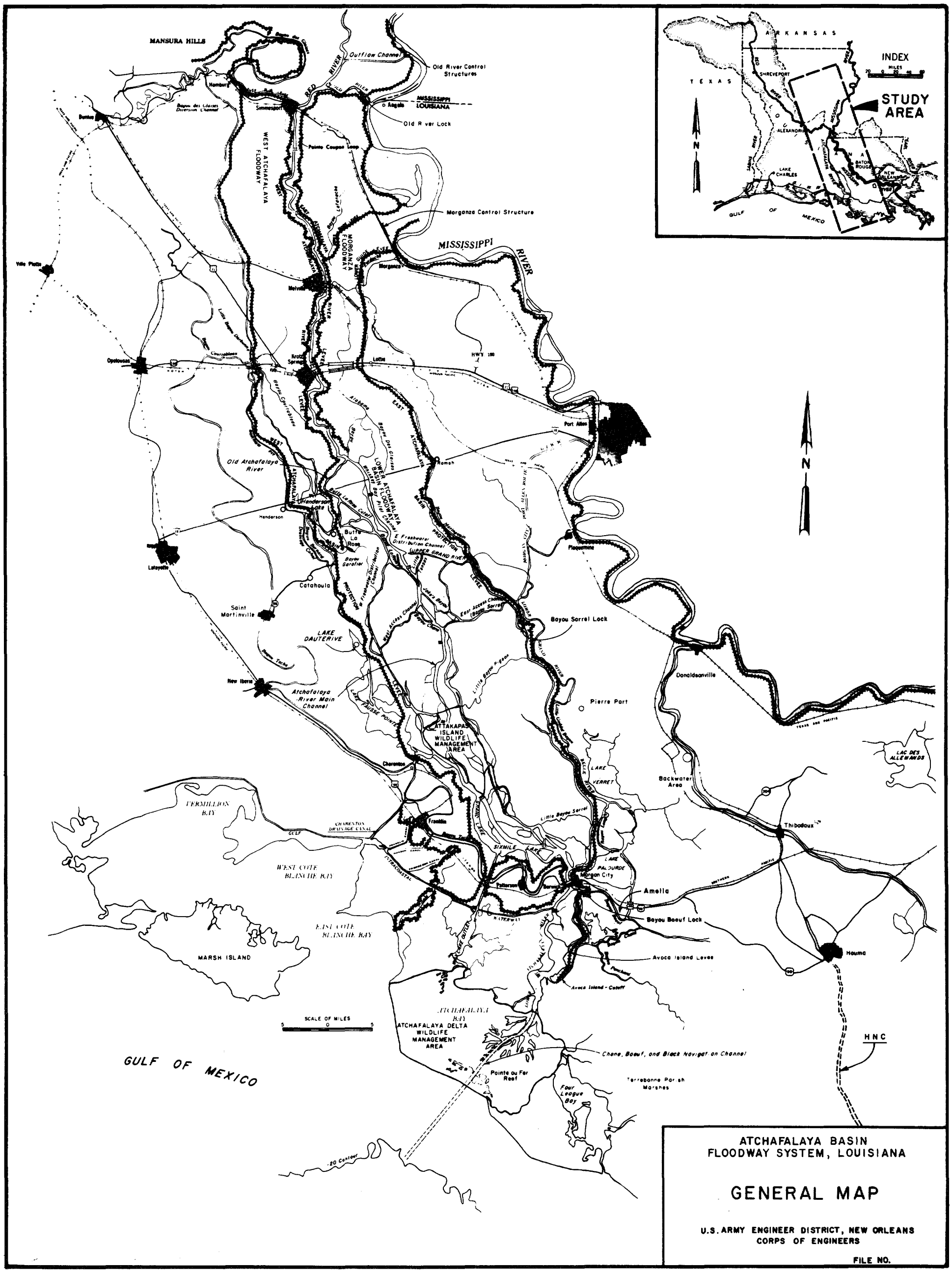
4. The recommendations for those features requiring authorization are made with the provision that, prior to implementation, the State of Louisiana will agree to comply with the following requirements:

a. Provide, without cost to the United States, all equivalent real estate interests necessary for the project purposes of flood control and environmental protection on lands owned by the State; and, at a cost to the United States not to exceed $32,000,000.00, all equivalent real estate interests necessary for the project purposes of flood control and environmental protection on lands to be acquired by the State for the project with Federal participation; and

b. Maintain and operate the nonflood control features of the project, or integral parts thereof, in accordance with regulations prescribed by the Secretary of the Army.

5. Governor David C. Treen, by letter dated 5 November 1980, recommended that management of nonflood control elements of the final Atchafalaya Basin Plan be through State of Louisiana agencies.

Thomas A. Sands
Brigadier General, USA
Reporting Officer



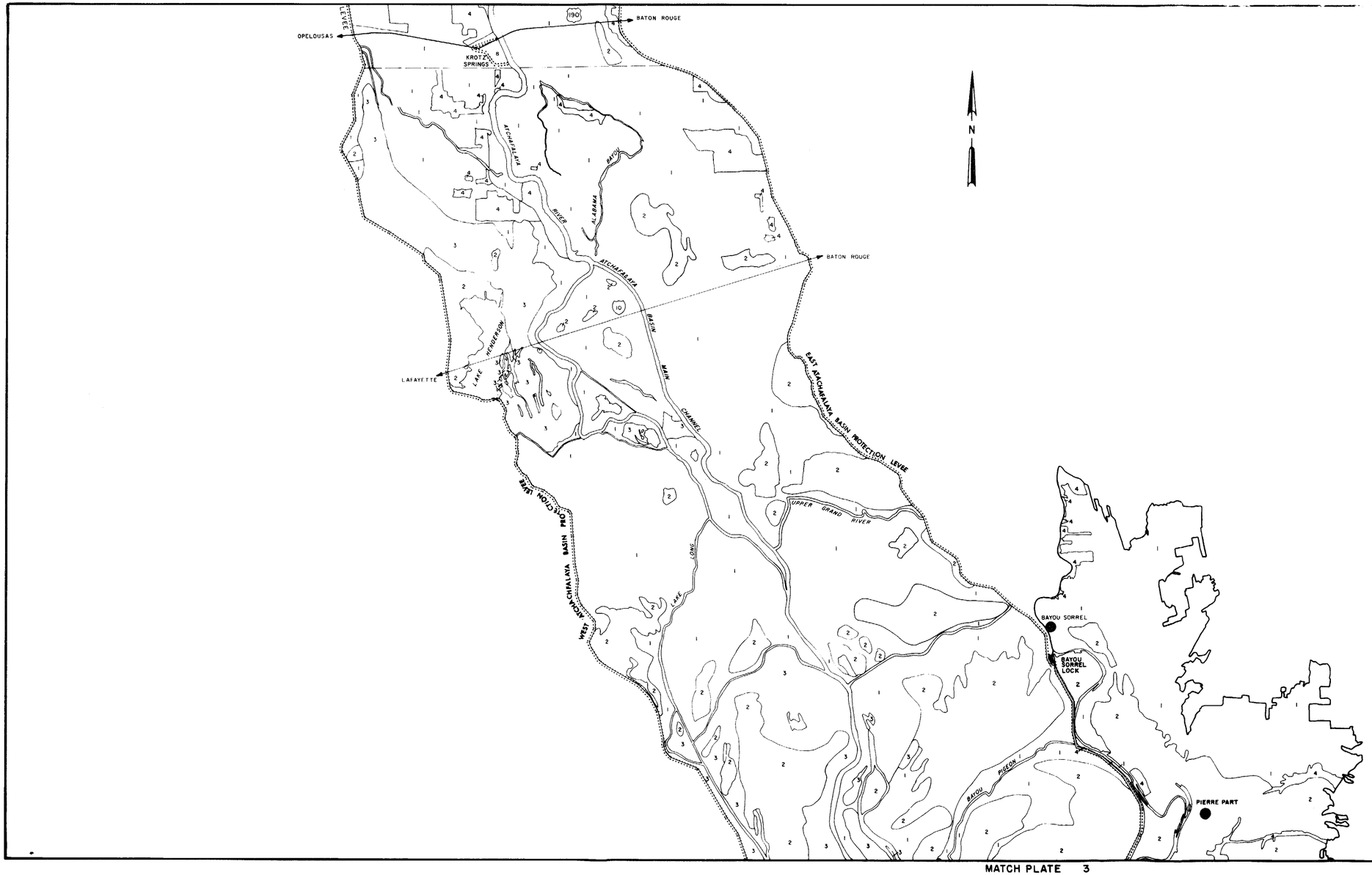
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

GENERAL MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE 1



LEGEND

1. MID TO LATE SUCCESSIONAL BOTTOMLAND HARDWOODS
2. CYPRESS-TUPELO OR CYPRESS-TUPELO MIXED WITH BOTTOMLAND HARDWOODS
3. EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS
4. CROPLANDS, PASTURE AND LEVEES
5. FRESH MARSH
6. BRACKISH MARCH
7. SALINE MARSH
8. URBAN DEVELOPMENT

UNDEFINED AREAS – OPEN WATER

SCALE 0 1 2 3 4 5 Miles

ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA

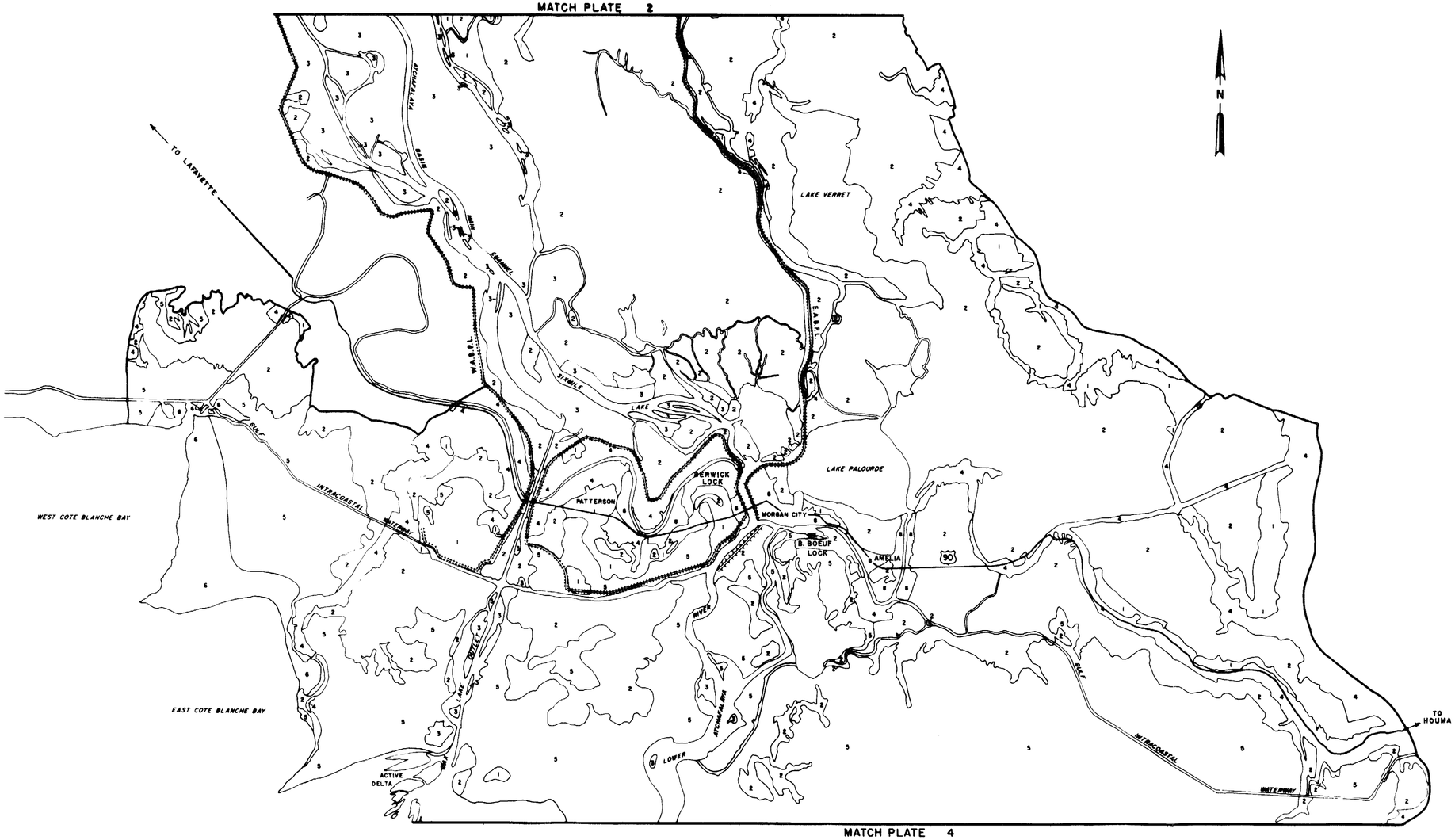
EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

MATCH PLATE 3

PLATE 2



LEGEND

1. MID TO LATE SUCCESSIONAL BOTTOMLAND HARDWOODS
2. CYPRESS-TUPELO OR CYPRESS-TUPELO MIXED WITH BOTTOMLAND HARDWOODS
3. EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS
4. CROPLANDS, PASTURE AND LEVEES
5. FRESH MARSH
6. BRACKISH MARSH
7. SALINE MARSH
8. URBAN DEVELOPMENT

UNDEFINED AREAS — OPEN WATER

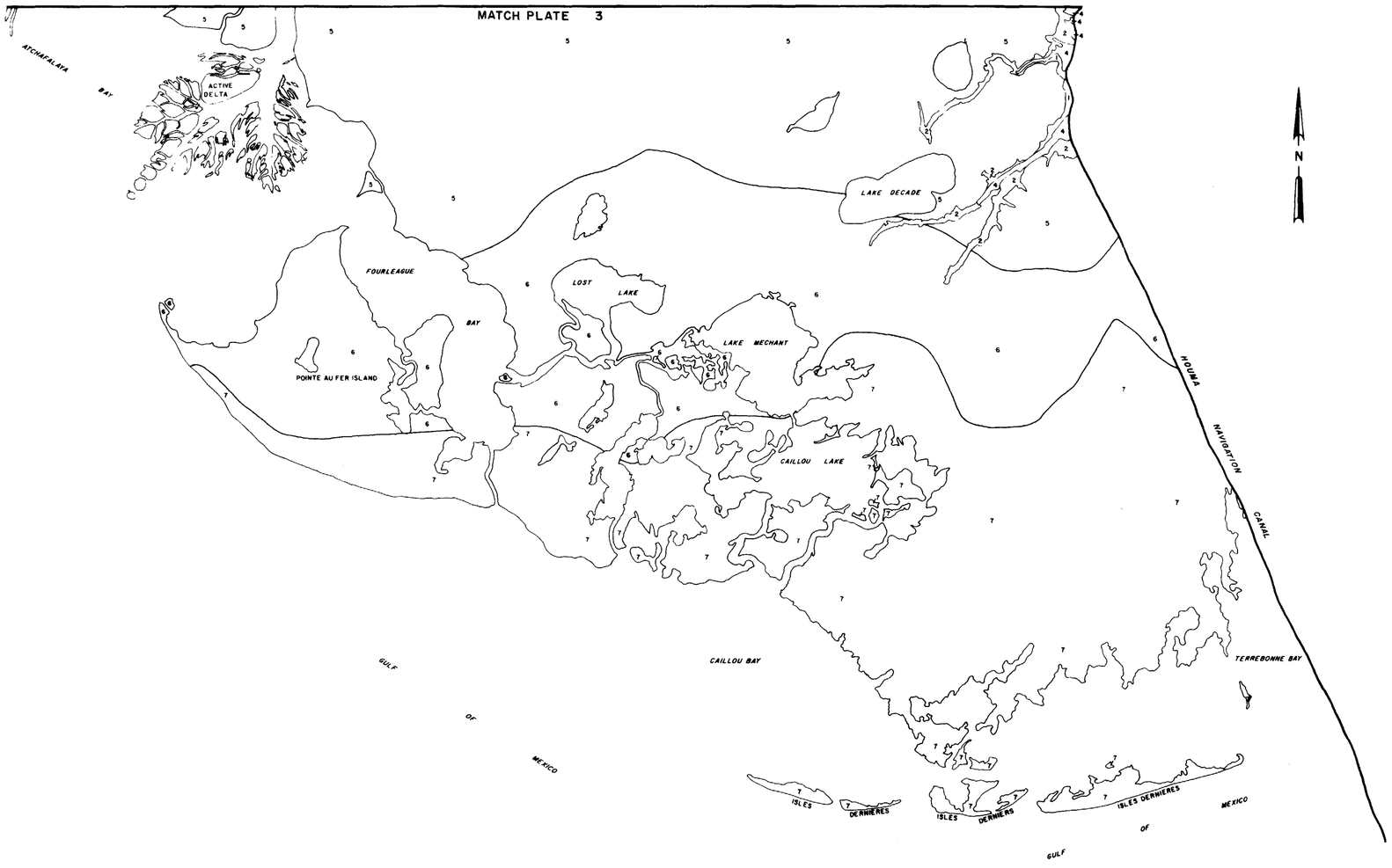
SCALE 0 1 2 3 4 5 Miles

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 3



LEGEND

1. MID TO LATE SUCCESSIONAL BOTTOMLAND HARDWOODS
2. CYPRESS-TUPELO OR CYPRESS-TUPELO MIXED WITH BOTTOMLAND HARDWOODS
3. EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS
4. CROPLANDS, PASTURE AND LEVEES
5. FRESH MARSH
6. BRACKISH MARCH
7. SALINE MARSH
8. URBAN DEVELOPMENT

UNDEFINED AREAS — OPEN WATER

SCALE
0 1 2 3 4 5 Miles

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE 4

LEGEND

1 ENLARGE LEVEE, 1973-80
2 ENLARGE LEVEE, 1981-86
3 ENLARGE LEVEE, POST 1986

NOTE: SCHEDULED ENLARGEMENT BASED ON 20 NOV. 1979 PB-2A

MAJORITY OF LEVEE ENLARGEMENT SOUTH OF TECHE RIDGE WILL OCCUR PRIOR TO 1986.

W-112 1 & 3
W-117 1
W-121 1
W-123 2
W-124 2

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MODIFICATION OF EXISTING LEVEE FEATURES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

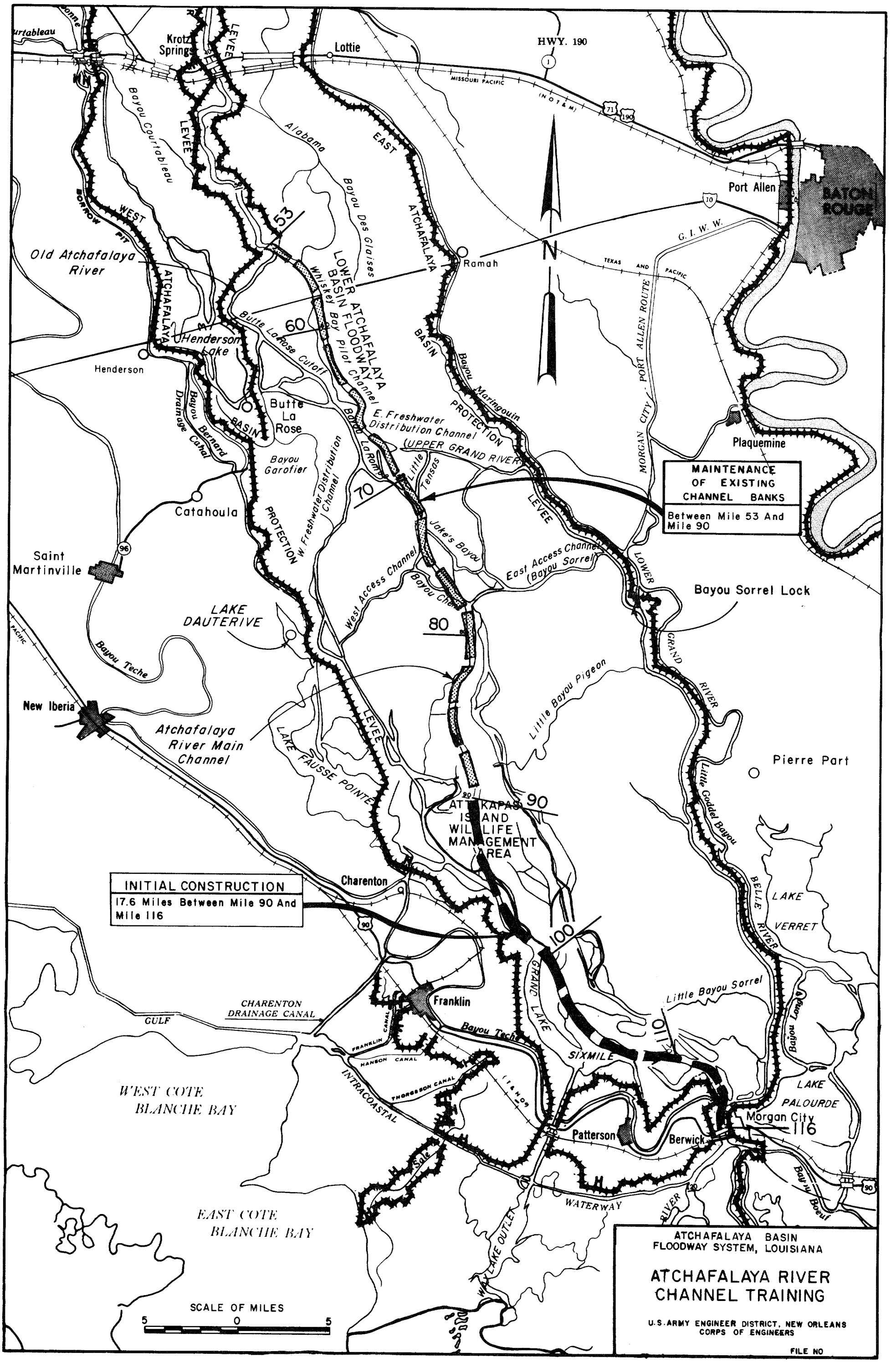


PLATE 6

PLATE 6

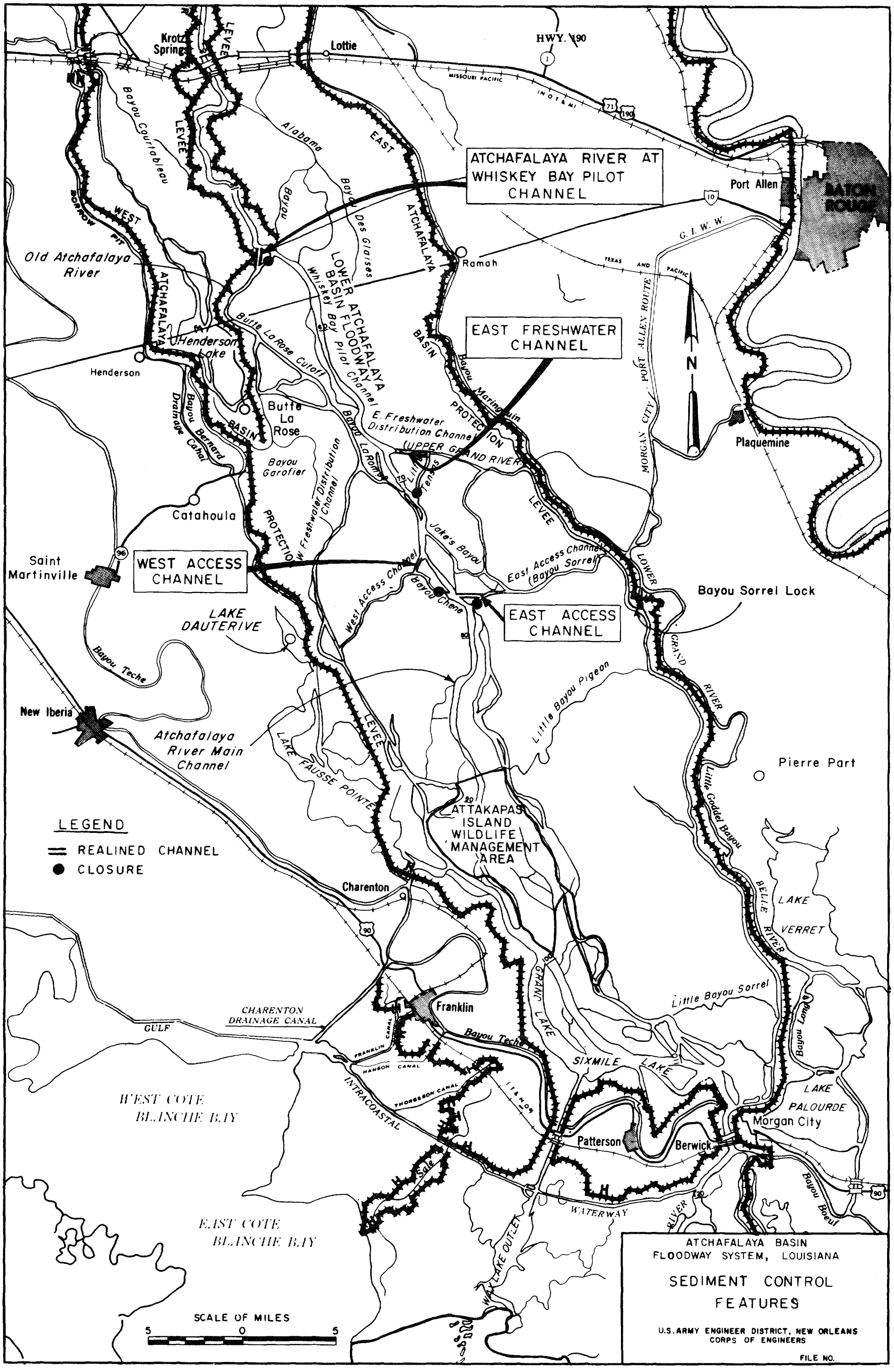
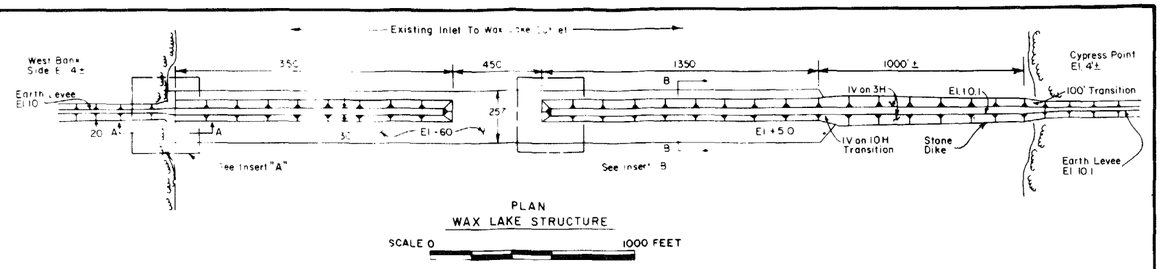


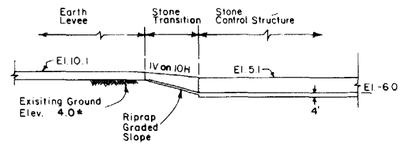
PLATE 7

PLATE 7

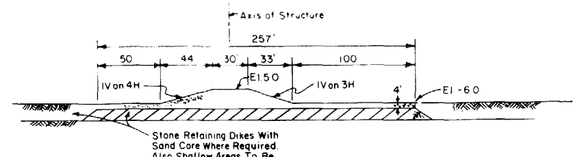


PLAN
WAX LAKE STRUCTURE

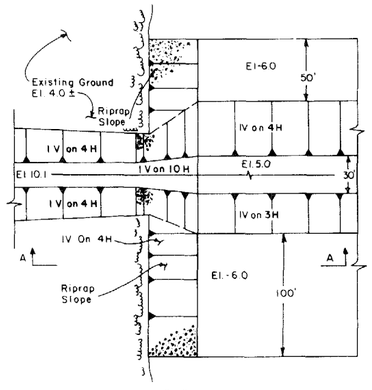
SCALE 0 1000 FEET



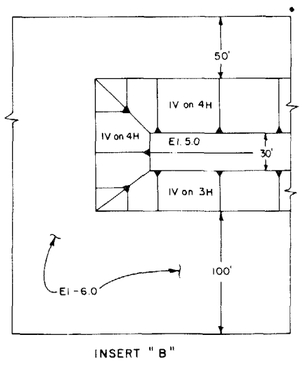
SECTION A-A



SECTION B-B



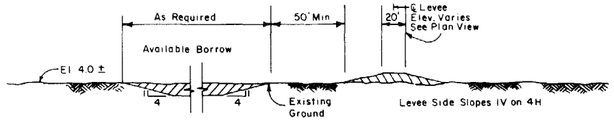
INSERT "A"



INSERT "B"

GENERAL NOTES

1. All Sections And Inserts Are To The Scale As Shown on Section D-D



SECTION D-D

SCALE 0 50 100 FEET

Note: The Existing Group Varies Considerably And The Elevation Shown is Not To Be Construed As Average or Typical.

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

WAX LAKE STRUCTURE & LEVEE
70 % LAR – 30% WLO

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE 8

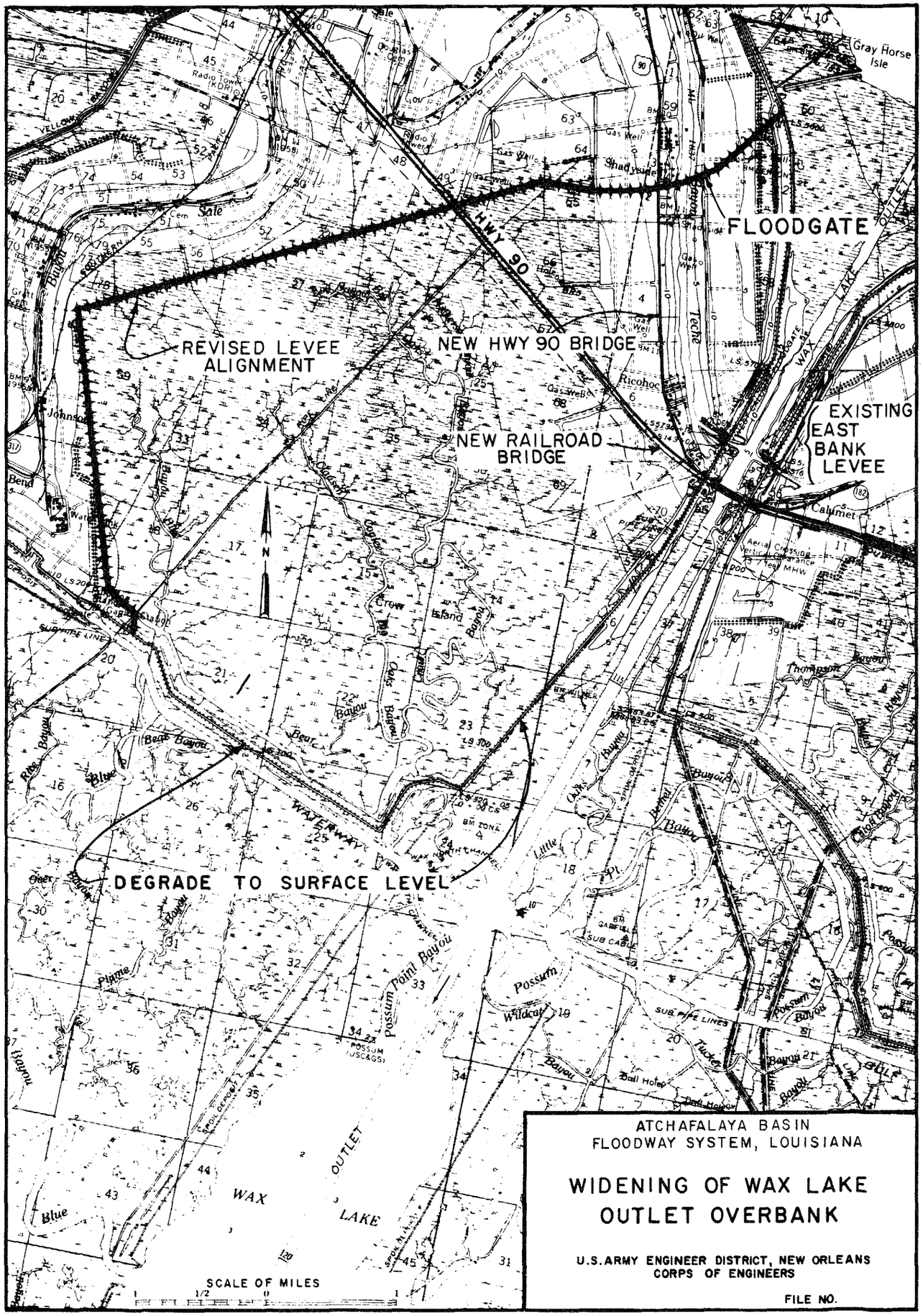

FLOODGATE
HWY 90
REVISED LEVEE ALIGNMENT
NEW HWY 90 BRIDGE
NEW RAILROAD BRIDGE
EXISTING EAST BANK LEVEE
DEGRADE TO SURFACE LEVEL
WAX LAKE OUTLET
Gray Horse Isle
Ricohoc
Calumet
Thompson
Possum Point Bayou
SCALE OF MILES
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
WIDENING OF WAX LAKE
OUTLET OVERBANK
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 9

FRESHWATER DIVERSION STRUCTURE

NAVIGATION STRUCTURE (WITH BAY SHORE ALINEMENT ONLY)

ADJACENT TO CHANNEL ALINEMENT

BAY SHORE ALINEMENT

LEGEND

LEVEE

NEW CHANNEL ALINEMENT

Sta. 680+00

Sta. 817+00

Sta. 970+00

Sta. 997+00

Sta. 1123+00

Sta. 1267+00

Sta. 1276+00

Sta. 1420+00

Sta. 1429+00

Sta. 1568+00

Sta. 1580+60

Sta. 1714+00

REACH 1

REACH 2

REACH 3

REACH 4

REACH 5

REACH 6

ATCHAFALAYA BAY

LITTLE BAY

GULF OF MEXICO

FOUR LEAGUE BAY

WAX LAKE OUTLET

LAKE SALVE

LAKE GASCHA

BATEMAN LAKE

SWEETBAY LAKE

LAKE CHAPEAU

PLUMB LAKE

AVOCA ISLAND

N

SCALE IN MILES

0 1 2 3 4 5

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

AVOCA ISLAND LEVEE EXTENSION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

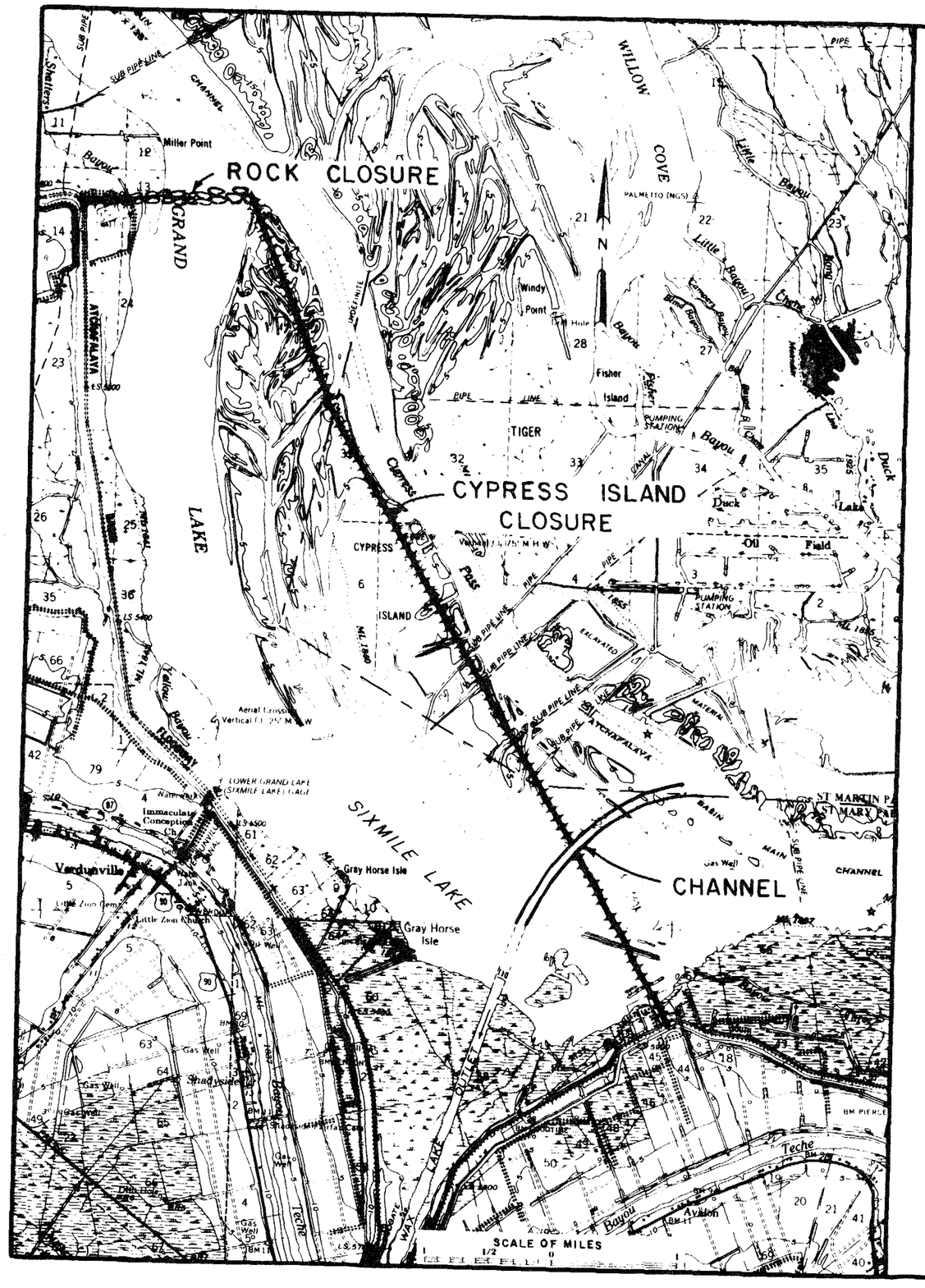
FILE NO.

PLATE 10

PLATE 10

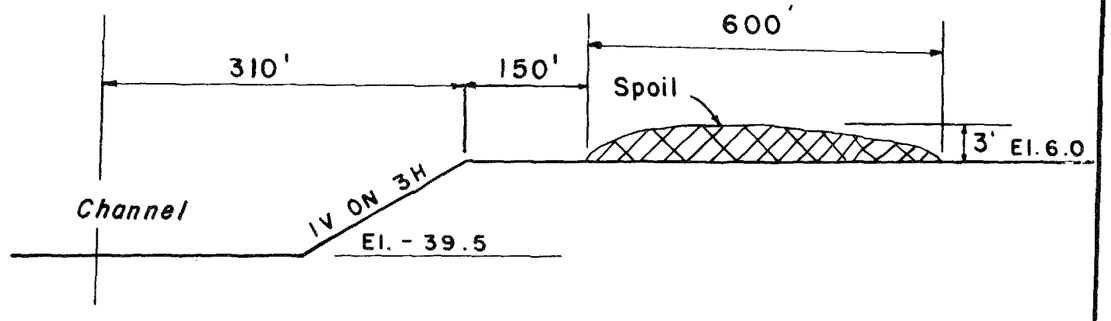
INLET STRUCTURE INTO WANDA CANAL
BAYOU EUGENE CLOSURE AND BOAT ROLLOVER STRUCTURE
West Access Channel
Florida Gas Canal
Wanda Canal
Lake Chicot (Isolated Portion)
Crossing Cove
ARM OF GRAND LAKE
Si Bon Canal
SI BON CANAL CLOSURE AND BOAT ROLLOVER STRUCTURE
Lake Chicot Oil and Gas Field
ATCHAFALAYA BASIN
LAKE CHICOT
MAIN CHANNEL
Chicot Pass
West Fork Chicot Pass
HOG ISLAND
GRAND LAKE
LAKE FAUSSE POINTE
BOAT ROLLOVER STRUCTURE
Buffalo Cove
Grand Lake (Isolated Portion)
OUTLET STRUCTURE
IMPROVED BOAT LAUNCH
ACCESS CANAL
INDICATED OPENING IN SPOIL BANK OR LEVEES FOR IMPROVEMENT OF WATER CIRCULATION
ATCHAFALAYA
IBERIA PARISH
ST MARY PARISH
LEVEE OR CLOSURES AS NEEDED
OUTLET STRUCTURE
FLOODWAY
Fishers Island
Big Pass
Cotton Point
Grand Avoille
Jeanerette Oil and Gas Field
CHARENTON FLOODGATE
Charenton
Charenton Oil and Gas Field
TAYLOR POINT CLOSURE
Taylor Point
ST MARTIN PARISH
ST MARY PARISH
OUTLET STRUCTURE
Boat Ramp
Linwood
Baldwin
Oxford
Oaklawn Manor
Camperdown
Choupique
Rodriquez
SCALE 1:62,500
1 1/2 0 1 Miles
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
PROPOSED FEATURES OF
BUFFALO COVE MANAGEMENT UNIT
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 11



TYPICAL SECTION

NOT TO SCALE



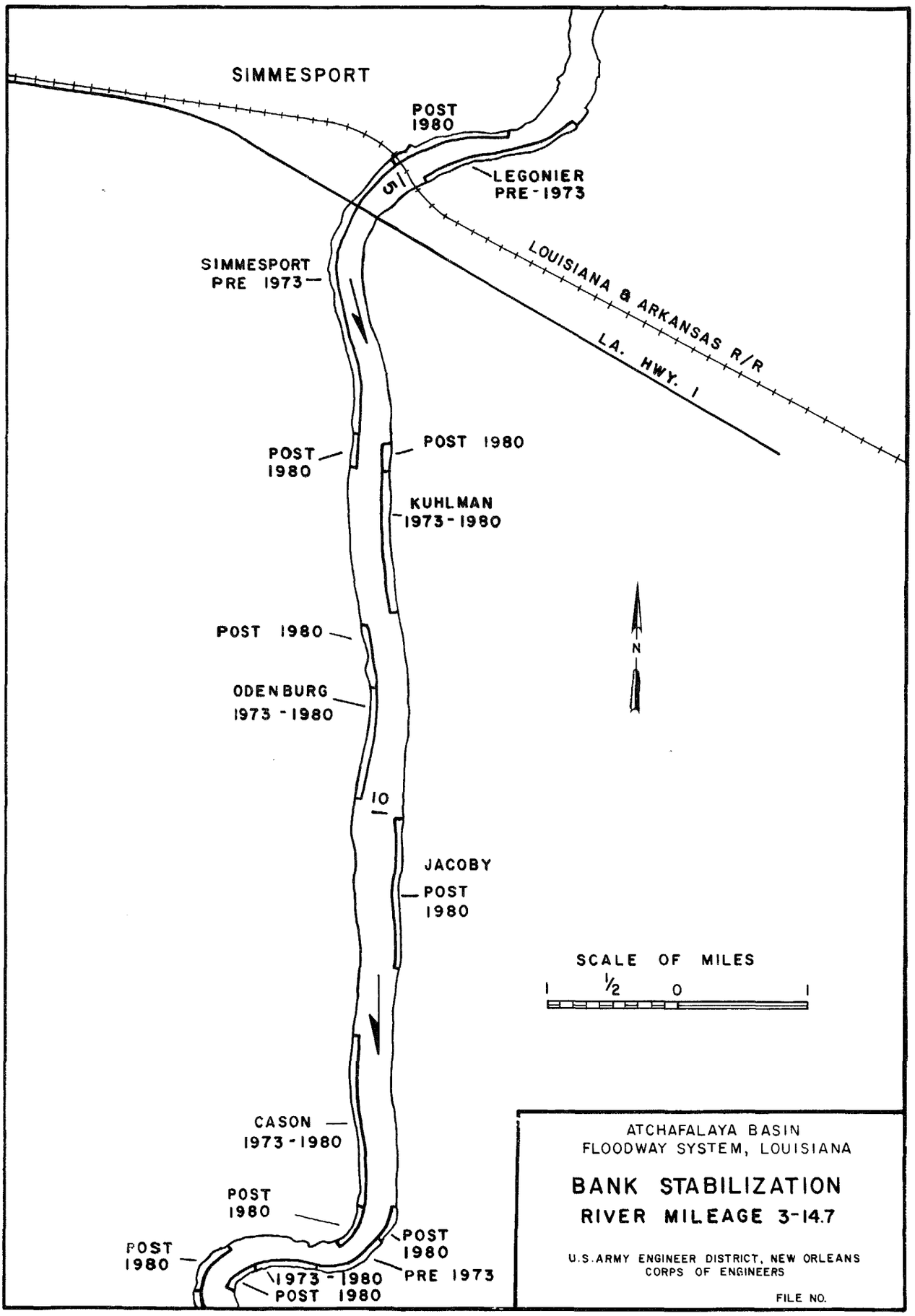
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

INCREASED SEDIMENT THROUGH WAX LAKE OUTLET

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE 12



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BANK STABILIZATION
RIVER MILEAGE 3-14.7

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE 13

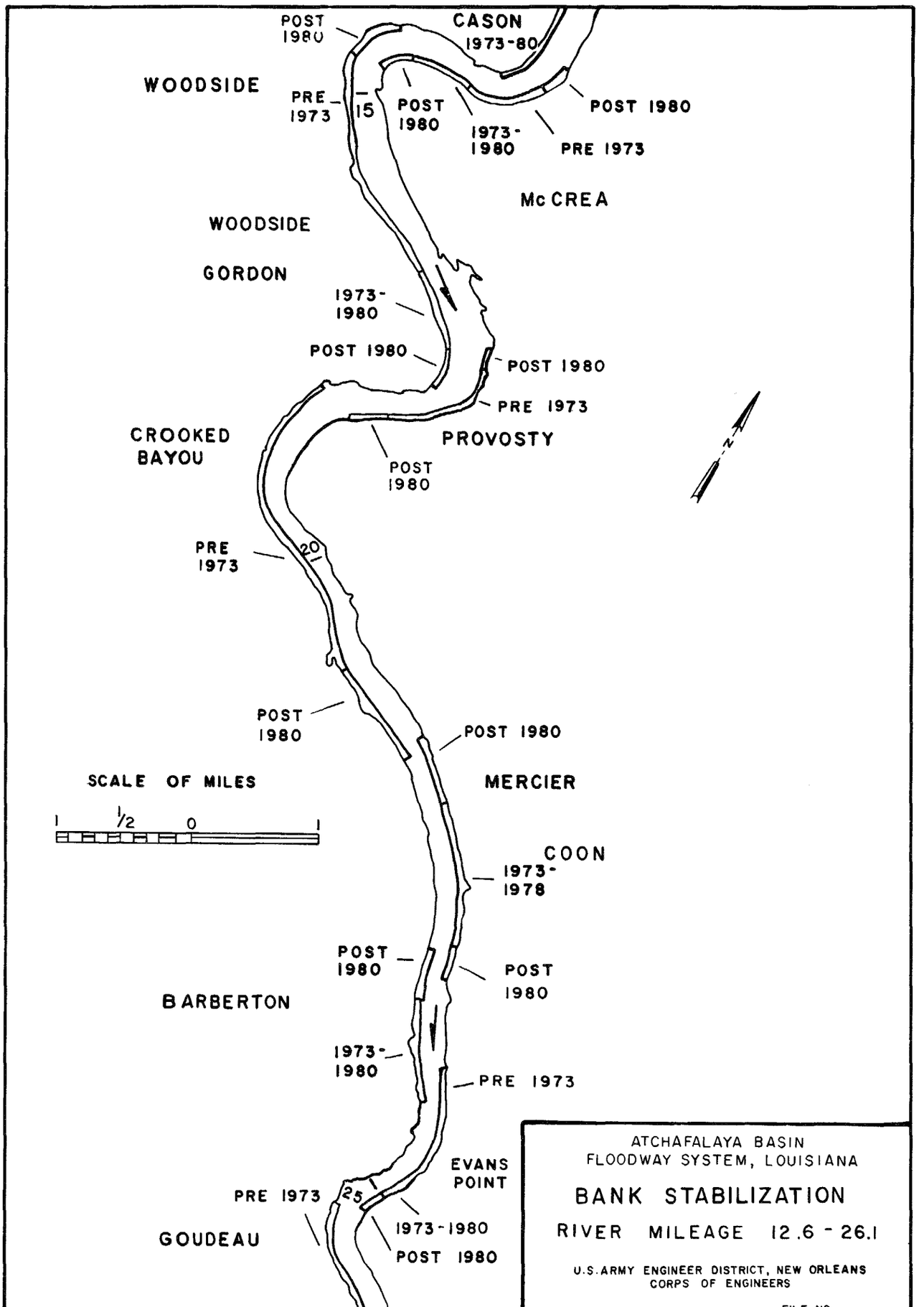

POST 1980
CASON 1973-80
WOODSIDE
PRE 1973
15
POST 1980
1973-1980
POST 1980
PRE 1973
McCREA
WOODSIDE
GORDON
1973-1980
POST 1980
POST 1980
PRE 1973
CROOKED BAYOU
PROVOSTY
POST 1980
PRE 1973
20
POST 1980
POST 1980
SCALE OF MILES
1 1/2 0 1
MERCIER
COON
1973-1978
POST 1980
POST 1980
BARBERTON
1973-1980
PRE 1973
EVANS POINT
PRE 1973
25
1973-1980
POST 1980
GOUDEAU
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 12.6 - 26.1
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 14

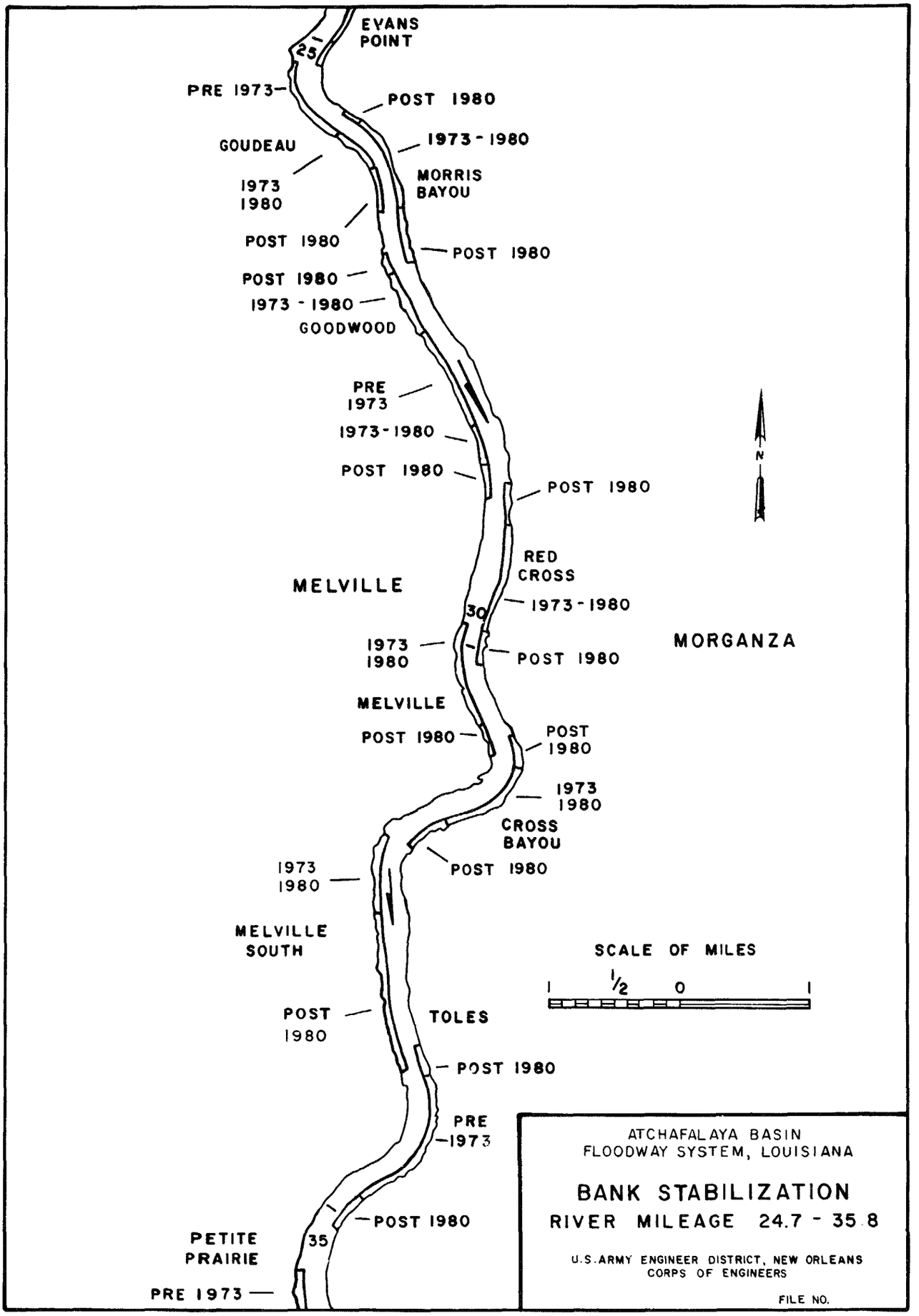

EVANS POINT
25
PRE 1973
POST 1980
1973 - 1980
GOUDEAU
1973
1980
MORRIS BAYOU
POST 1980
POST 1980
POST 1980
1973 - 1980
GOODWOOD
PRE 1973
1973-1980
POST 1980
POST 1980
N
RED CROSS
MELVILLE
1973 - 1980
30
MORGANZA
1973
1980
POST 1980
MELVILLE
POST 1980
POST 1980
1973
1980
CROSS BAYOU
POST 1980
1973
1980
MELVILLE SOUTH
SCALE OF MILES
1 1/2 0 1
POST
1980
TOLES
POST 1980
PRE
1973
POST 1980
35
PETITE PRAIRIE
PRE 1973
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 24.7 - 35.8
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 15

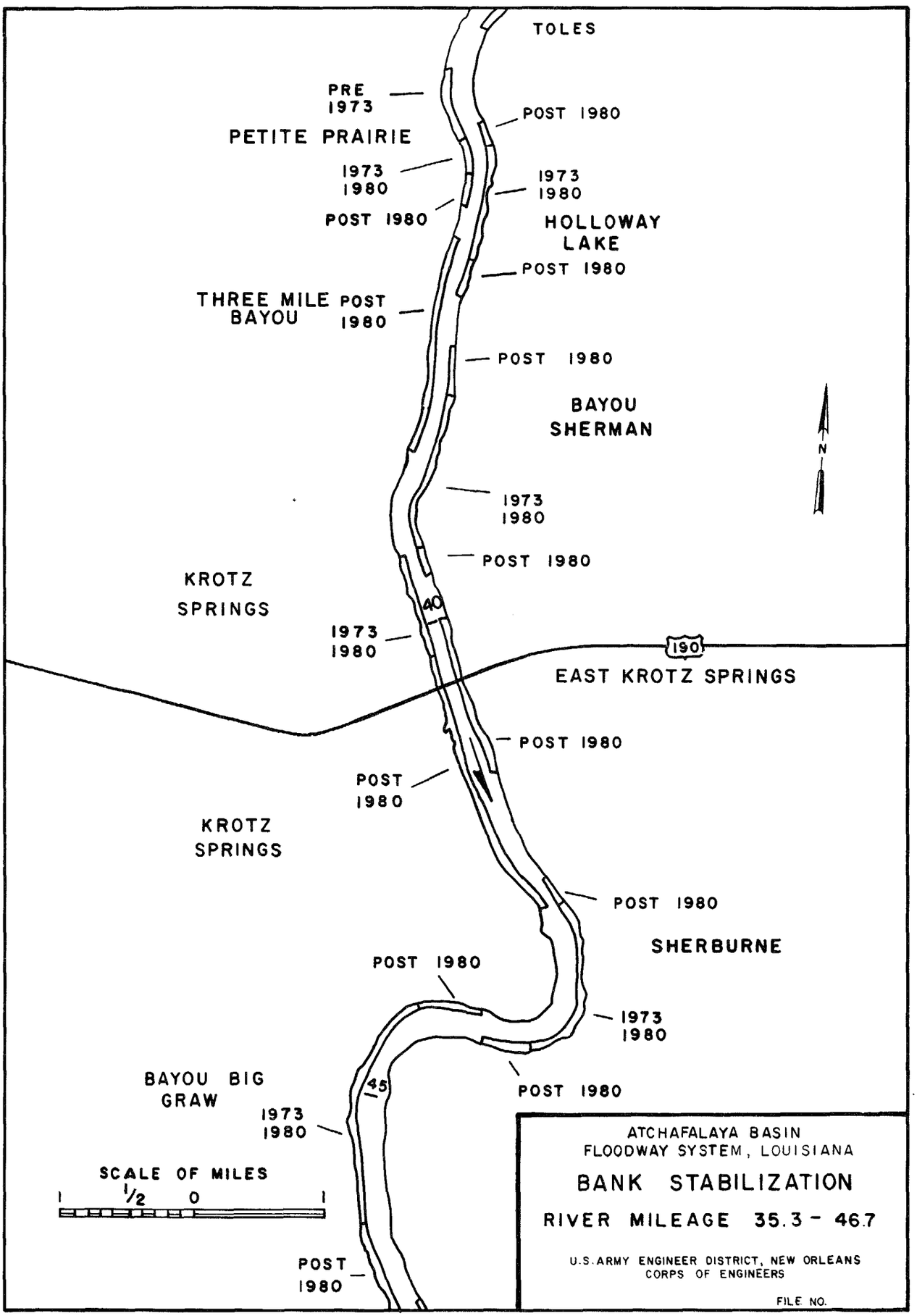

TOLES
PRE 1973
POST 1980
PETITE PRAIRIE
1973 1980
POST 1980
1973 1980
HOLLOWAY LAKE
POST 1980
THREE MILE BAYOU
POST 1980
POST 1980
BAYOU SHERMAN
N
1973 1980
POST 1980
KROTZ SPRINGS
40
1973 1980
190
EAST KROTZ SPRINGS
POST 1980
POST 1980
KROTZ SPRINGS
POST 1980
SHERBURNE
POST 1980
1973 1980
BAYOU BIG GRAW
45
1973 1980
POST 1980
SCALE OF MILES
1/2 0 1
POST 1980
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 35.3 - 46.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 16

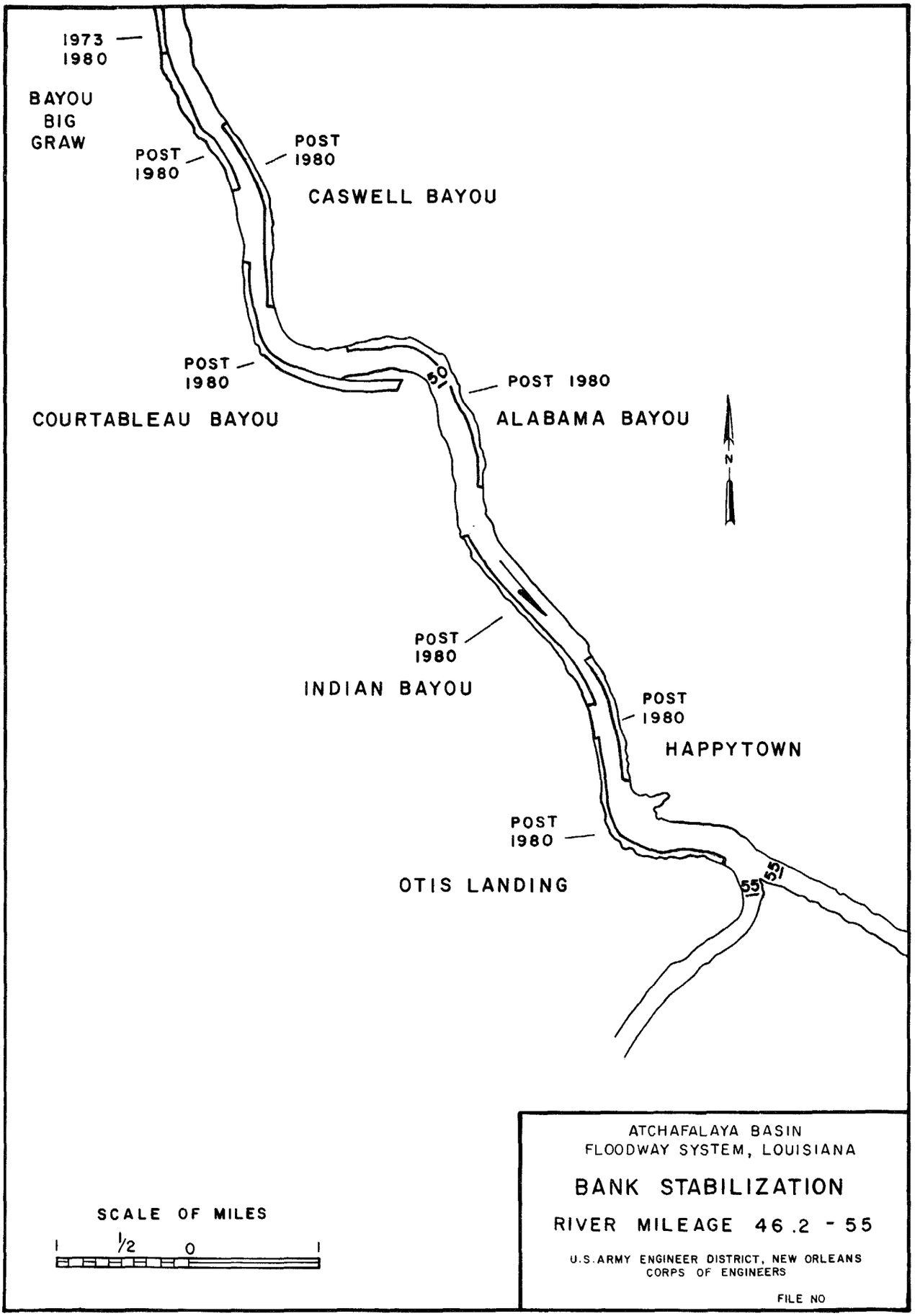

1973
1980
BAYOU
BIG
GRAW
POST
1980
POST
1980
CASWELL BAYOU
POST
1980
50
POST 1980
COURTABLEAU BAYOU
ALABAMA BAYOU
N
POST
1980
INDIAN BAYOU
POST
1980
HAPPYTOWN
POST
1980
OTIS LANDING
55
55
SCALE OF MILES
1
1/2
0
1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 46.2 - 55
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO

PLATE 17

TYPICAL SECTION

NOT TO SCALE

TYPICAL PROFILE

NOT TO SCALE

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

LOWER ATCHAFALAYA RIVER AND WAX LAKE OUTLET CHANNEL TRAINING

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 18

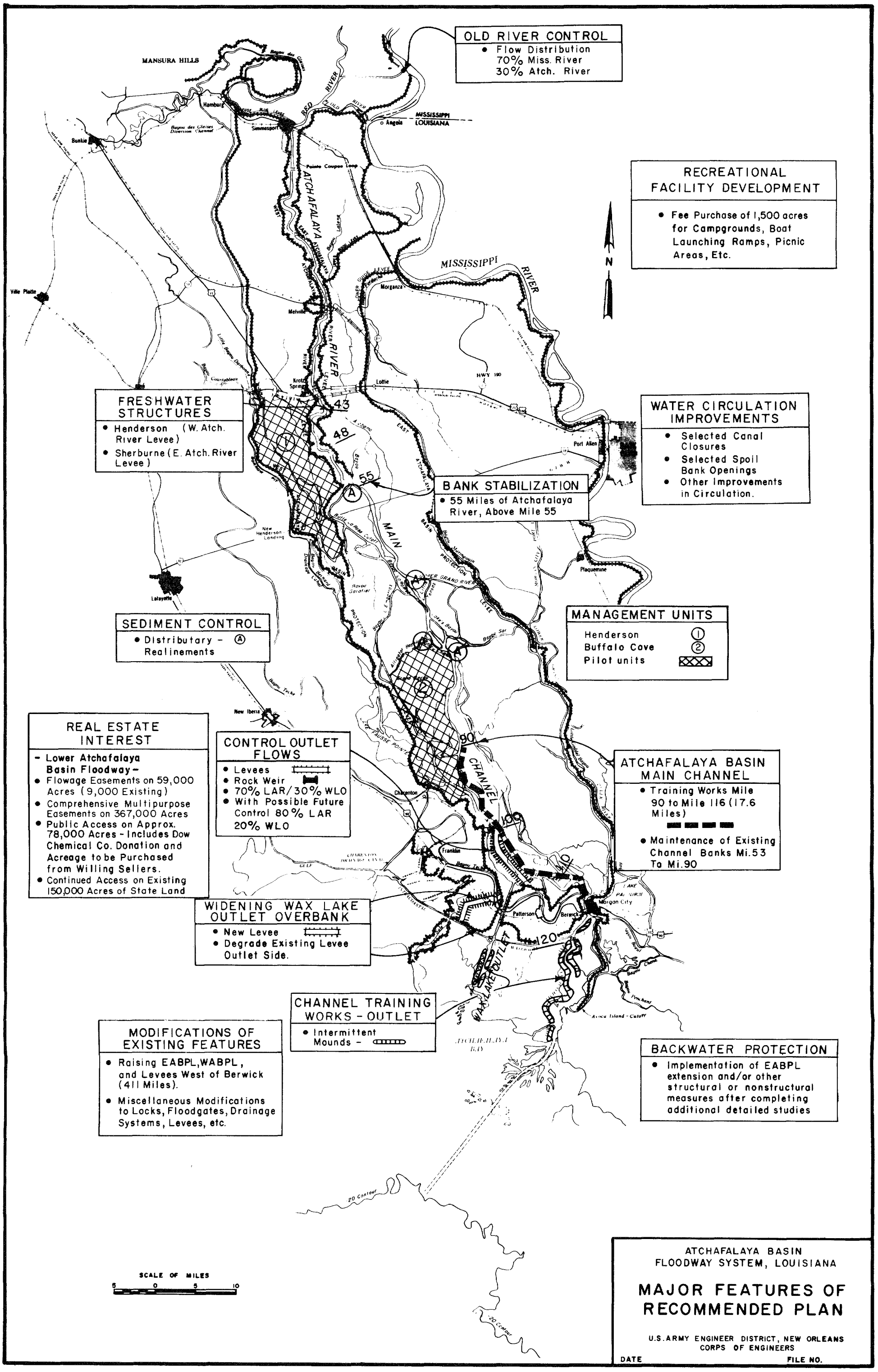

OLD RIVER CONTROL
• Flow Distribution
70% Miss. River
30% Atch. River
RECREATIONAL FACILITY DEVELOPMENT
• Fee Purchase of 1,500 acres for Campgrounds, Boat Launching Ramps, Picnic Areas, Etc.
N
FRESHWATER STRUCTURES
• Henderson (W. Atch. River Levee)
• Sherburne (E. Atch. River Levee)
WATER CIRCULATION IMPROVEMENTS
• Selected Canal Closures
• Selected Spoil Bank Openings
• Other Improvements in Circulation.
BANK STABILIZATION
• 55 Miles of Atchafalaya River, Above Mile 55
SEDIMENT CONTROL
• Distributary - Ⓐ Realinements
MANAGEMENT UNITS
Henderson ①
Buffalo Cove ②
Pilot units
REAL ESTATE INTEREST
- Lower Atchafalaya Basin Floodway -
• Flowage Easements on 59,000 Acres (9,000 Existing)
• Comprehensive Multipurpose Easements on 367,000 Acres
• Public Access on Approx. 78,000 Acres - Includes Dow Chemical Co. Donation and Acreage to be Purchased from Willing Sellers.
• Continued Access on Existing 150,000 Acres of State Land
CONTROL OUTLET FLOWS
• Levees
• Rock Weir
• 70% LAR/30% WLO
• With Possible Future Control 80% LAR 20% WLO
ATCHAFALAYA BASIN MAIN CHANNEL
• Training Works Mile 90 to Mile 116 (17.6 Miles)
• Maintenance of Existing Channel Banks Mi.53 To Mi.90
WIDENING WAX LAKE OUTLET OVERBANK
• New Levee
• Degrade Existing Levee Outlet Side.
CHANNEL TRAINING WORKS - OUTLET
• Intermittent Mounds -
MODIFICATIONS OF EXISTING FEATURES
• Raising EABPL, WABPL, and Levees West of Berwick (41 Miles).
• Miscellaneous Modifications to Locks, Floodgates, Drainage Systems, Levees, etc.
BACKWATER PROTECTION
• Implementation of EABPL extension and/or other structural or nonstructural measures after completing additional detailed studies
SCALE OF MILES
5 0 5 10
MANSURA HILLS
Hamburg
Bunkie
Simmesport
Red River
Old River
Mississippi
Louisiana
Angola
Pointe Coupee Loop
Atchafalaya
West Atchafalaya
East Atchafalaya
Bayou Latenk
Mississippi River
Morganza
Ville Platte
Melville
Lottie
Krotz Springs
Port Allen
Baton Rouge
Plaquemine
Lafayette
New Iberia
Chacahoula
Franklin
Morgan City
Patterson
Berwick
Amoca Island - Cutoff
Bayou Teche
Bayou Courtableau
Bayou des Glaises Diversion Channel
Bayou Darbonne
Bayou Boeuf
Bayou Sorrel
Bayou Lafourche
Bayou Terrebonne
Bayou Penchant
Lake Palourde
Gulf
20 Contour
-20 Contour
PLATE 19
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAJOR FEATURES OF RECOMMENDED PLAN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE 19

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING OR POTENTIAL PRIME AND UNIQUE FARMLANDS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 20

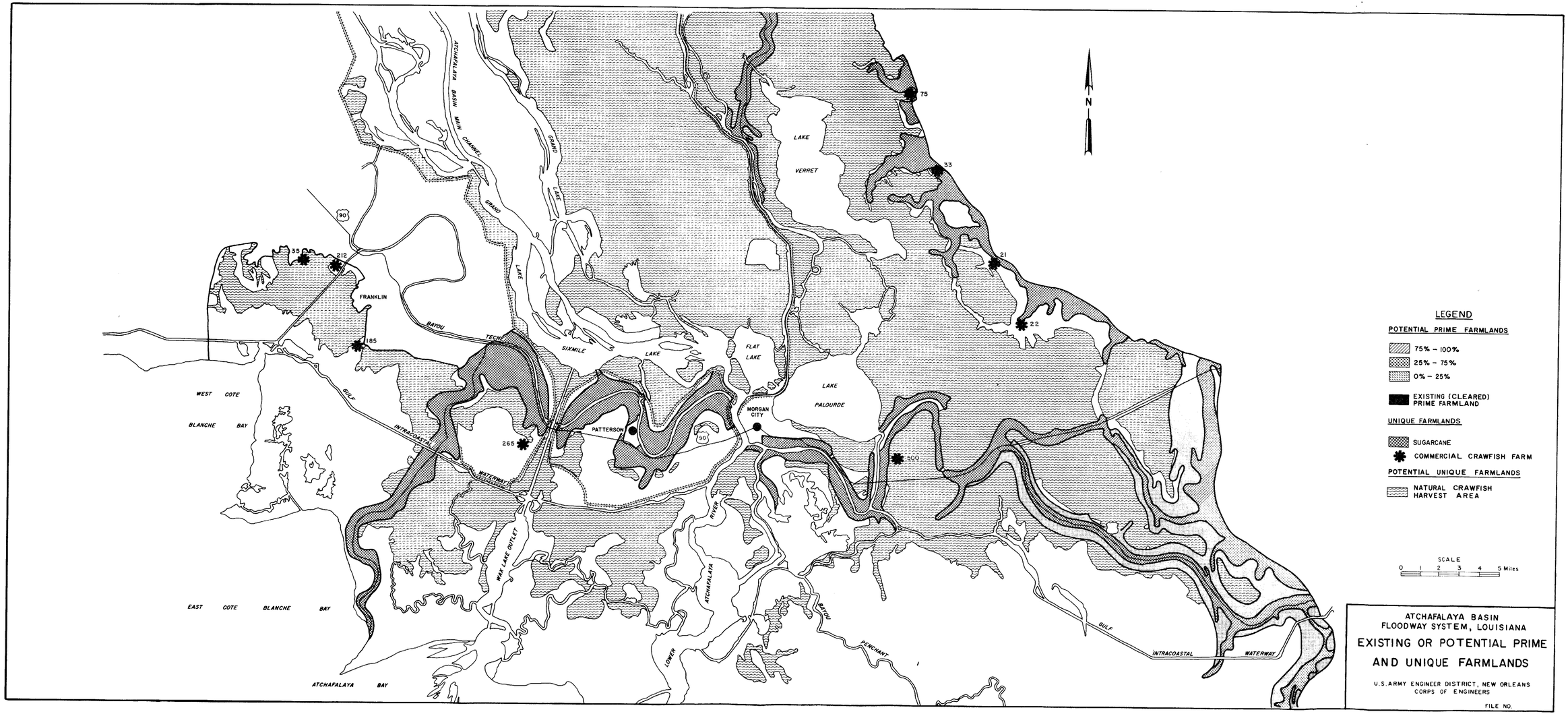

ATCHAFALAYA BASIN MAIN CHANNEL
GRAND LAKE
LAKE VERRET
75
33
21
22
N
90
35
212
FRANKLIN
BAYOU TECHE
185
SIXMILE LAKE
FLAT LAKE
LAKE PALOURDE
MORGAN CITY
PATTERSON
265
500
WEST COTE BLANCHE BAY
GULF INTRACOASTAL WATERWAY
WAX LAKE OUTLET
ATCHAFALAYA RIVER
BAYOU PENCHANT
LOWER
EAST COTE BLANCHE BAY
ATCHAFALAYA BAY
LEGEND
POTENTIAL PRIME FARMLANDS
75% – 100%
25% – 75%
0% – 25%
EXISTING (CLEARED) PRIME FARMLAND
UNIQUE FARMLANDS
SUGARCANE
COMMERCIAL CRAWFISH FARM
POTENTIAL UNIQUE FARMLANDS
NATURAL CRAWFISH HARVEST AREA
SCALE
0 1 2 3 4 5 Miles
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
EXISTING OR POTENTIAL PRIME AND UNIQUE FARMLANDS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 21

N
ATCHAFALAYA
BAY
FOURLEAGUE
BAY
LOST LAKE
LAKE MECHANT
CAILLOU LAKE
GULF
OF
MEXICO
CAILLOU
BAY
LAKE
PELTO
LEGEND
POTENTIAL PRIME FARMLANDS
75% - 100%
25% - 75%
0% - 25%
EXISTING (CLEARED)
PRIME FARMLAND
UNIQUE FARMLANDS
SUGARCANE
COMMERCIAL CRAWFISH FARM
POTENTIAL UNIQUE FARMLANDS
NATURAL CRAWFISH
HARVEST AREA
SCALE
0 1 2 3 4 5 Miles
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
EXISTING OR POTENTIAL PRIME
AND UNIQUE FARMLANDS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE 22

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

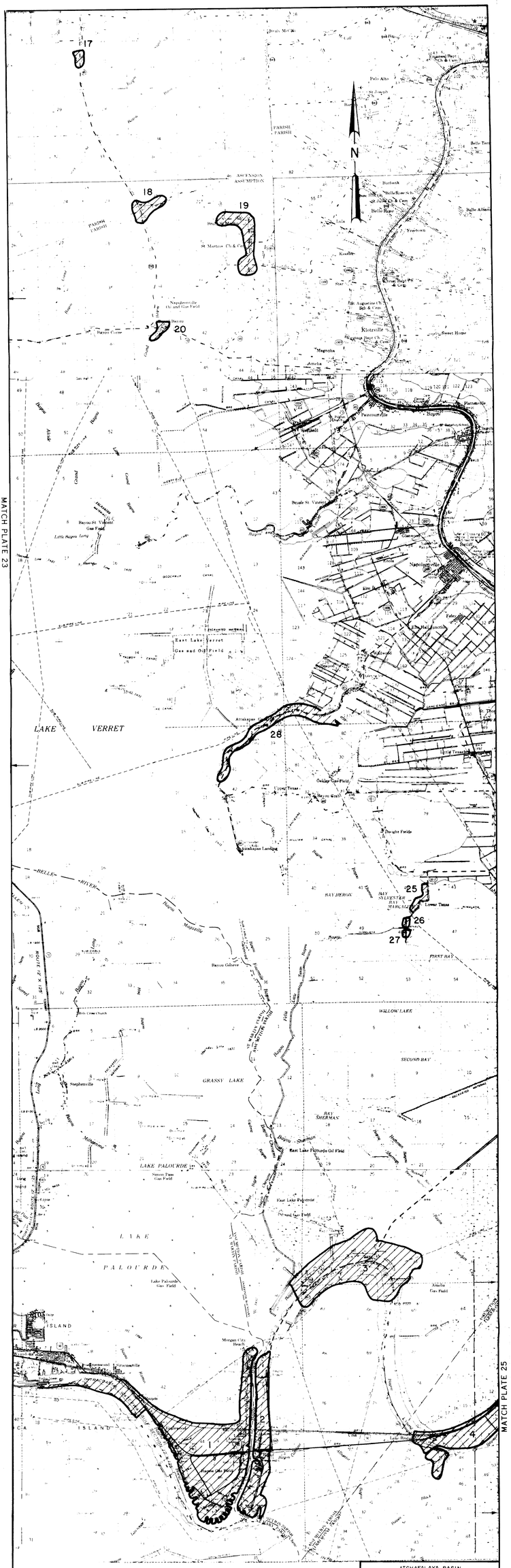
RING LEVEE ALTERNATIVE FOR BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

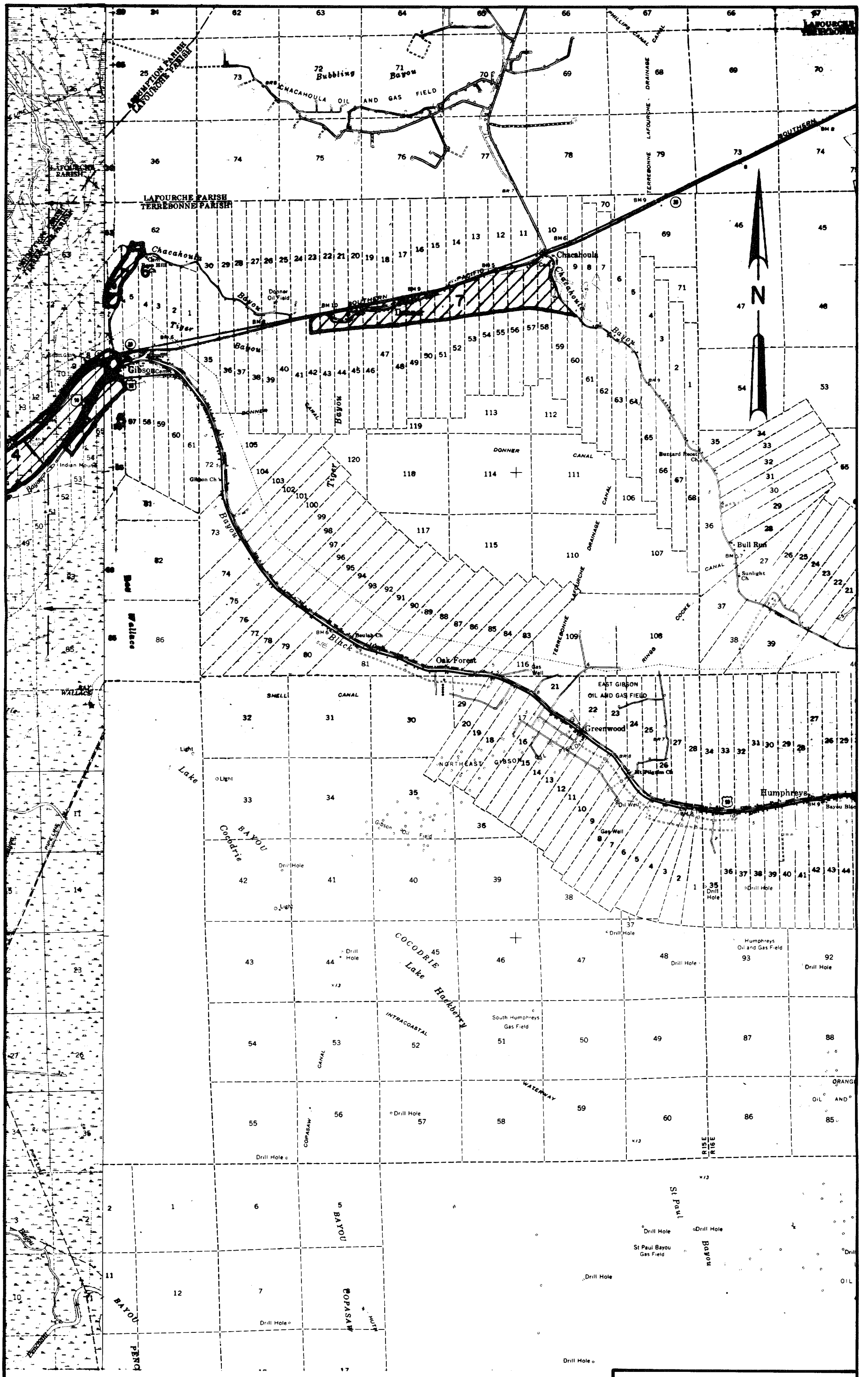
FILE NO.

PLATE 23

PLATE 23


17
18
19
20
28
25
26
27
1
2
3
4
N
LAKE VERRET
GRASSY LAKE
LAKE PALOURDE
WILLOW LAKE
SECOND BAY
FIRST BAY
BAY HERON
BELLE RIVER
ATCHAFALAYA RIVER
MORGAN CITY
PATTERSON
BERWICK
ASSUMPTION PARISH
ST. MARTIN PARISH
ST. MARY PARISH
ST. MARY'S EFFLUENT CANAL
ST. MARY'S LEVEE
ST. MARY'S EFFLUENT CANAL AND LEVEE
MATCH PLATE 23
MATCH PLATE 25
PLATE 24
PLATE 24
LEGEND
RINGED AREAS
SCALE OF MILES
1/2 0
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
RING LEVEE ALTERNATIVE
FOR BACKWATER AREA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

MATCH PLATE 24



LEGEND

RINGED AREAS

SCALE OF MILES

1 1/2 0 1

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

RING LEVEE ALTERNATIVE FOR BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE 25

PLATE 25

ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA

FEASIBILITY STUDY

US Army Corps
of Engineers
MISSISSIPPI RIVER COMMISSION
New Orleans District

JANUARY 1982

VOLUME 2

TECHNICAL APPENDIXES
A, B, C, AND D

VOLUME 1

MAIN REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2

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APPENDIX B - FORMULATION, ASSESSMENT, AND EVALUATION OF DETAILED PLANS

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PROBLEM IDENTIFICATION

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Appendix A

PROBLEM IDENTIFICATION

A.0.1. This appendix presents detailed technical descriptions which support the Introduction and Problem Identification sections of the main report for the Atchafalaya Basin (Water and Land Resources), Louisiana, feasibility study and for the Atchafalaya Basin project Phase I General Design Memorandum (GDM). Study authorities are quoted verbatim and prior studies and reports are identified and discussed. An array of data, tables, figures, and plates augments the narrative representation of existing conditions, future conditions with and without proposed project features, and problems and needs of the area. Material encompasses physical and biological resources that constitute the environmental setting, characteristics of the people, area economy and development and currently authorized projects. This document also contains information delineating planning objectives and constraints and specific data on analyses and projections.

Section 1 - STUDY AUTHORITY

A.1.1. The Atchafalaya Basin Study is unique because it combines pre-authorization studies of some features with post-authorization studies of others. Authorities for this combined study are presented in the following paragraphs.

A.1.2. The pre-authorization study was authorized by resolutions of the Committees on Public Works of both the US Senate and US House of Representatives. These are as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Chief of Engineers of the United States Army, be, and is hereby requested to examine and review the project for flood control of the Mississippi River in its alluvial valley, and for its improvement from the Head of the Passes to Cape Girardeau, Missouri, as authorized by the Flood Control Act approved May 15, 1928, and as amended by subsequent acts of Congress, including Public Law 780, Eighty-third Congress, which modified the basic project to include a plan of improvement for the control of Old and Atchafalaya Rivers, to determine whether, in the light of changed conditions, any modifications, extensions, or additions to the existing Old River control system or to its operation are warranted at this time." Adopted 11 June 1968.

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Chief of Engineers, United States Army, in cooperation with other interested Federal and State agencies, such as the Environmental Protection Agency, and the Louisiana Stream Control Commission, be, and is hereby requested to review the report on the Mississippi River and Tributaries Project, published as House Document Numbered 308, Eighty-eighth Congress, and other pertinent reports, with a view to developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin, Louisiana, which would include provisions for reductions of siltation; improvement of water quality; and possible improvements of the area for commercial and sport fishing." Adopted 23 March 1972.

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, That the Chief of Engineers of the United States Army, in cooperation with other interested Federal and State agencies, including the Environmental Protection Agency and the Louisiana Stream

Control Commission, is hereby requested to review the report on the Mississippi River and Tributaries Project, published in House Document Numbered 308, 88th Congress, and other pertinent reports, with a view to developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya Basin, Louisiana, which would include provisions for reduction of siltation, improvement of water quality, and possible improvement of the area for commercial and sport fishing." Adopted 14 June 1972.

A.1.3. The post-authorization study or GDM was authorized pursuant to the discretionary authority of the Secretary of the Army acting through the Chief of Engineers by letter dated 18 June 1976, and endorsed by the President of the Mississippi River Commission on 28 June 1976. This authority provided for the study to address, in specific terms, alternate plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project.

A.1.4. These authorities were addressed in a single study because of the interrelationships among the purposes authorized.

Section 2 - PRIOR STUDIES AND REPORTS

A.2.1. Many studies and reports have been prepared that have specifically affected the Atchafalaya Basin. Those bearing on the results of this study are described in the following paragraphs.

A.2.2. "Flood Control of the Mississippi River in its Alluvial Valley," published as House Document No. 90, 70th Congress, resulted in the authorization, by the Flood Control Act of 1928, of the Mississippi River and Tributaries (MR&T) project. The Atchafalaya Basin Floodway is an original feature of this comprehensive flood control project.

A.2.3. "Flood Control Works in the Alluvial Valley of the Mississippi River," published as House Committee on Flood Control Document No. 1, 74th Congress, resulted in the authorization, under Public Law 678-74, of modification of the MR&T project. Additional features included Morganza and West Atchafalaya Floodways, improvement of the discharge capacity of the Atchafalaya River channel, Wax Lake Outlet, appurtenant works, and provision for purchase of flowage easements in the West Atchafalaya Floodway.

A.2.4. "Comprehensive Flood-Control Plan for Ohio and Lower Mississippi River," published as House Committee on Flood Control Document No. 1, 75th Congress, resulted in authorization, by Public Law 761-75, to purchase easements in the Morganza and Lower Atchafalaya Basin Floodway.

A.2.5. "Flood Control on the Lower Mississippi," published as House Document No. 359, 77th Congress, resulted in authorization, by the Flood Control Act of 18 August 1941, for construction of levees to protect the Tensas-Cocodrie area from Red River backwater flooding. The recommended deauthorization of Boeuf and Eudora Floodways, original features of the MR&T project, was also specified by the 1941 Act.

A.2.6. "Boeuf and Tensas Rivers and Bayou Macon, Arkansas and Louisiana," published as Senate Document No. 151, 78th Congress, resulted in the authorization, by the Flood Control Act of 22 December 1944, of the Tensas Basin, Boeuf and Tensas Rivers, etc., Arkansas and Louisiana, project. The project, as amended, provides flood control and major drainage outlets for 5,300 square miles of southeast Arkansas and northeast Louisiana.

A.2.7. "Plaquemine-Morgan City Route, Intracoastal Waterway, Louisiana," published as Senate Document No. 242, 79th Congress, was a review of reports with a view to modifying the Louisiana-Texas Intracoastal Waterway project to include a Plaquemine-Morgan City route. The recommendations were authorized by the River and Harbor Act of 24 July 1946.

A.2.8. "Flood Control and Drainage on Bayou Lafourche, Louisiana," published as Senate Document No. 191, 79th Congress, resulted in authorization, under the Flood Control Act of 24 July 1946, of improvements to Bayou Lafourche for flood control and drainage purposes. The project was incorporated into the existing Boeuf and Tensas Rivers and Bayou Macon project.

A.2.9. "Ouachita River and Tributaries, Arkansas and Louisiana," published as Senate Document No. 117, 81st Congress, resulted in authorization, by the Flood Control Act of 17 May 1950, to modify the Red River backwater project for the Tensas-Cocodrie area and to incorporate the Jonesville, Louisiana, project into the MR&T project.

A.2.10. "Atchafalaya River, Louisiana," published as Senate Document No. 53, 82nd Congress, recommended construction of a 12- by 125-foot navigation channel for the Atchafalaya River from Morgan City to the Mississippi River via Old River. The report, "Mississippi River and Tributaries with Respect to Old River Control," published as House Document No. 478, 83rd Congress, recommended that the MR&T project be modified to provide for control of flows from the Mississippi River into the Atchafalaya River and basin by mechanically operated control structures at Old River and a navigation lock to permit continued traffic from the Mississippi to the Atchafalaya. These recommendations were authorized by Public Law 780-83, the Flood Control Act of 3 September 1954.

A.2.11. "Boeuf and Tensas Rivers and Bayou Macon, Arkansas, and Louisiana," published as House Document No. 108, 85th Congress, was a review of reports on the project with the same title, with a view to determine whether additional improvements were advisable. The report's recommendations resulted in authorization, by the Flood Control Act of 3 July 1958, of 62 additional miles of channel improvements on seven tributaries of Boeuf River and Bayou Macon. The work was considered a modification of the existing project.

A.2.12. In July 1963, a project plan for the Atchafalaya Floodway was completed and defined in a GDM entitled "Flood Control, Mississippi River and Tributaries, Atchafalaya Basin Floodway, Louisiana." This GDM provided for accelerating the development of a stable central channel by dredging, and by closure of most distributary channels. It also provided for features designed to mitigate for fish and wildlife losses. These latter features were:

- The east and west navigation access channels,
- The east and west freshwater diversion channels,
- Water diversion structures in the east Atchafalaya River levee in the vicinity of Sherburne and in the west Atchafalaya River levee near Courtableau, and

- Provision for access points and boat-launching ramps for recreational purposes.

A.2.13. The objectives of the project plan and the mitigation features are to:

- Stabilize the project flowline to minimize future changes in levee height,
- Reduce overbank siltation,
- Maintain distribution of freshwater to the backswamps, and
- Provide for cross-basin navigation.

A.2.14. The 1963 GDM provided an in-depth engineering evaluation of the ongoing channel enlargement and recommended an ultimate cross-sectional area of 100,000 square feet below the project flowline. The proposal provided for incremental channel enlargement from the existing area to 40,000 square feet, and then successively to 60,000, 80,000, and 100,000 square feet.

A.2.15. "Mississippi River and Tributaries," published as House Document No. 308, 88th Congress, resulted in authorization, under the Flood Control Act of 27 October 1965, for modification of the MR&T project. One feature provides for construction of additional protection levees in the Red River backwater area and a pumping plant in the Tensas area capable of discharging 3,000 cubic feet per second (cfs).

A.2.16. "Morgan City and Vicinity, Louisiana," published as House Document No. 167, 89th Congress, resulted in the authorization, under the Flood Control Act of 27 October 1965, of the Morgan City, Louisiana and Vicinity hurricane protection project. Authorized work provides for construction of new levees, raising of existing levees, and construction of gravity control structures to protect Morgan City, Franklin, and contiguous areas from hurricane-induced flooding.

A.2.17. "Teche-Vermilion Basins, Louisiana," published as House Document No. 524, 89th Congress, resulted in authorization, under the Flood Control Act of 1966, of the Teche-Vermilion Basins, Louisiana, (Water Supply) feature of the MR&T project. The project provides for the diversion of fresh water from the Atchafalaya River by various works during low-flow periods to mitigate water quality and quantity problems caused, in part, by the loss of natural drainage intercepted by the Atchafalaya Basin Floodway levees.

A.2.18. "Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana," published as House Document No. 155, 90th Congress, resulted in authorization, under the River and Harbor Act of 1968, of

the project of the same title. The project provides for 20- by 400-foot navigation channels on Bayous Boeuf and Black from the latitude of US Highway 90 to the Gulf Intracoastal Waterway (GIWW), along the GIWW, and along Bayou Chene to the 20-foot contour of the Gulf of Mexico, except that the width in Bayou Boeuf would be reduced to not less than 300 feet where necessary because of industrial developments on both sides of the bayou.

A.2.19. "Eastern Rapides and South-Central Avoyelles Parishes, Louisiana," published as Senate Document No. 113, 91st Congress, resulted in authorization, under the Flood Control Act of 31 December 1970, of the project of the same title. The project is located in Rapides, Avoyelles, St. Landry, and St. Martin Parishes, Louisiana. The plan of improvement provides an outlet for floodflows and drainage from the Chatlin Lake Canal area via Bayou du Lac, Bayou Des Glaises, and the West Atchafalaya Basin Protection Levee borrow pit which ultimately discharges into the Atchafalaya Basin Floodway.

A.2.20. "Bushley Bayou Area of Red River Backwater Area, Louisiana," resulted in authorization, under the Water and Resources Development Act of 1974, of the Bushley Bayou feature of the MR&T project. The project provides for levees and appurtenant works to protect the Bushley Bayou area from backwater flooding.

Section 3 - STUDIES OF OTHERS

A.3.1. A number of studies of the Atchafalaya Basin have been prepared by Federal, state, and local agencies. Studies conducted by the US Fish and Wildlife Service (US FWS) are listed as follows:

- Kennedy, R. S. 1977. Ecological analysis and population estimate of the birds of the Atchafalaya River Basin in Louisiana. Ph. D. dissertation. Louisiana State University, Baton Rouge. 201 pp.

- McClanahan, R. D. 1975. A study of the herbaceous understory vegetation in the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 227 pp.

- Huer, E. T., Jr. 1976. Relative abundance of squirrels and rabbits in three forest types of the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 50 pp.

- Mermilliod, W. J., III. 1976. Life history and ecology of the large river shrimp, Macrobrachium Ohione (Smith). M.S. Thesis. Louisiana State University, Baton Rouge.

- Horst, J. W. 1976. Aspects of the biology of striped bass, Morone saxatilis (Walbaum), of the Atchafalaya Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge.

- Sabins, D. S. 1978. Fish standing crop estimates in the Atchafalaya Basin, Louisiana. Louisiana Cooperative Fishery Research Unit, School of Forestry and Wildlife Management, Louisiana State University, Baton Rouge.

- Hebert, C. E. 1977. A population study of small mammals in the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 96 pp.

- Nichols, J. D. 1973. A survey of furbearer resources of the Atchafalaya Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 184 pp.

- Evans, D. L., Jr. 1976. Relative abundance of deer and woodcock in the three major forest types of the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 111 pp.

- Kenikoff, M. 1977. A study of the life history and ecology of the red swamp crawfish, Procambarus Clarkii, in the Lower

Atchafalaya Basin Floodway. Department of Biology, University of Southwestern Louisiana, Lafayette. 81 pp.

• Hyde, K. M. and J. D. Newsom. 1970. A study of a wild turkey population in the Atchafalaya River Basin of Louisiana. Louisiana Cooperative Wildlife Research Unit, Louisiana State University, Baton Rouge. 23 pp.

• Hoese, H. D. 1976. Study of sport and commercial fishes of the Atchafalaya Bay Region. Dept. of Biology, University of Southwestern Louisiana, Lafayette. 52 pp.

• Bryan, C. F., F. N. Truesdale, D. S. Sabins, and C. R. Demas. 1974. A limnological survey of the Atchafalaya Basin. Louisiana Cooperative Fishery Research Unit, Louisiana State University, Baton Rouge. 208 pp.

• Bryan, C. F., F. M. Truesdale, D. S. Sabins. 1975. A limnological survey of the Atchafalaya Basin. Louisiana Cooperative Fishery Research Unit, Louisiana State University, Baton Rouge. 203 pp.

• Bryan, C. F., D. J. Demont, D. S. Sabins, and J. P. Newman, Jr. 1976. A limnological survey of the Atchafalaya Basin. Louisiana Cooperative Fishery Research Unit, Louisiana State University, Baton Rouge. 285 pp.

• Beck, L. T. 1977. Distribution and relative abundance of freshwater macroinvertebrates of the Lower Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 134 pp.

• Binford, M. W. 1977. Crustacean and zooplankton ecology of the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 97 pp.

• Holland, L. E. 1977. Distribution and ecology of plankton rotifera in the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge.

• O'Brien, T. P. 1977. Crawfishes of the Atchafalaya Basin, Louisiana with emphasis on those species of commercial importance. M.S. Thesis. Louisiana State University, Baton Rouge. 78 pp.

• Levine, S. J. 1977. Food and feeding habitats of juveniles and adults of selected forage and sport fishes in the Atchafalaya Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge.

- Sager, D. R. 1976. Temporal and spatial distribution of phytoplankton in the Lower Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 157 pp.

- Keiser, E. D. 1976. Herpetofaunal survey of the Atchafalaya River Basin, Louisiana. Center for Environmental Studies, Lafayette Natural History Museum, Lafayette. 811 pp.

A.3.2. Numerous reports on the Atchafalaya Basin, issued by the US Environmental Protection Agency, are listed subsequently.

- van Beek, J. L., A. L. Harmon, C. L. Wax and K. M. Wicker. 1979. Operation of the Old River Control Structure, Atchafalaya Basin: An evaluation from a multi-use management standpoint. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-79-073. 36 pp.

- van Beek, J. L. 1979. Hydraulics of Atchafalaya Basin main channel system: Considerations from a multi-use management standpoint. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-79-036. 36 pp.

- van Beek, J. L., W. G. Smith, J. W. Smith, and P. Light. 1977. Plan and concepts for multi-use management of the Atchafalaya Basin. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-77-062. 204 pp.

- van Beek, J. L., K. Whicker, and B. Small. 1978. A comparison of three flooding regimes Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-78-106. 79 pp.

- van Beek, J. L. and B. Small. 1977. Survey of cross-basin boat traffic Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-77-090. 28 pp.

- Hern, S. C. and V. W. Lambou. 1979. Pesticides and polychlorinated biphenols in the Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-79-061. 80 pp.

- Hern, S. C., W. D. Taylor, L. R. Williams, V. W. Lambou, M. K. Morris, F. A. Morris, J. W. Hilgert. 1978. Distribution and importance of phytoplankton in the Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-78-001. 194 pp.

- Hern, S. C., V. W. Lambou, and J. R. Butch. 1980. Descriptive water quality for the Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-80-014. 168 pp.

- Hern, S. C. and V. W. Lambou. 1978. Productivity responses to changes in hydrological regimes in the Atchafalaya Basin, Louisiana. Proceedings of the International Symposium on Environmental Effects of Hydraulic Engineering Works, Knoxville, Tennessee. Sept. 1978. 9 pp.

- Gagliano, S. M. and J. L. van Beek. 1975. Environmental base and management study Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA-600/5-75-006. 220 pp.

A.3.3. Other studies conducted are as follows:

- Soileau, L. D., K. C. Smith, R. Hunter, C. E. Knight, D. M. Soileau, W. E. Shell, Jr., and D. W. Hayne. 1975. Atchafalaya Basin usage study (a cooperative study conducted by the Louisiana Wildlife and Fisheries Commission and the US Army Corps of Engineers, New Orleans District). US Army Corps of Engineers, New Orleans District, New Orleans, Louisiana. 85 pp.

- Bell, F. W. 1981. Recreational benefits from the Atchafalaya River Basin (a joint study sponsored by the US Fish and Wildlife Service and the US Army Corps of Engineers, New Orleans District). Report on contract 14-16-009-80-009. Dept. of Economics, Florida State University, Tallahassee. 227 pp.

- Bell, F. W. 1981. Commercial fishing and trapping: An economic analysis of the Atchafalaya River Basin (a joint study sponsored by the US Fish and Wildlife Service and the US Army Corps of Engineers, New Orleans District). Report on contract 14-16-009-80-009. Dept. of Economics, Florida State University, Tallahassee. 294 pp.

Section 4 - HISTORY AND STATUS OF PLANS AND IMPROVEMENTS

History of Atchafalaya River Development

EARLY HISTORY

A.4.1. Reconstructions based on geologic evidence show that conditions for the formation of the Atchafalaya distributary were established during the 1500's. According to Elliott (1932), a map dated 1578 drawn by Monk Ptolemy, who accompanied DeSoto's expedition in 1542, shows conclusively that the Atchafalaya River then, as now, served as an outlet for the Mississippi River. Accounts of later visitors to the Atchafalaya Basin reflect its impassability. Highly cultivated and well-populated communities quickly developed on the alluvial ridges of Bayous Teche and Lafourche, which flanked the region; but no overland trails of any consequence crossed the basin as only water transportation was feasible. The most traveled route across the basin was by way of Bayou Plaquemine, through Upper Grand River and Bayou Courtableau to Bayou Teche at Opelousas. The Atchafalaya River itself was a minor stream because flow was restricted by a massive raft of logs at the upper end. The river was joined near the present end of its leveed segment by Bayou Courtableau and flowed diagonally across the basin along the modern Upper Grand River. At its junction with Bayou Plaquemine, the Atchafalaya River flowed south along what is now Lower Grand River and emptied into the lake area north of Berwick Bay. Darby's map of Louisiana from "A Geographical Description of the State of Louisiana, 1816" shows this relationship (see Plate A-1) and refers to the entire stream as the Atchafalaya. South of the cross-basin portion now represented by Upper Grand River, Darby shows only minor dendritic drainage into a very large Grand Lake, which he called Lake Chetimaches. The overall accuracy of this map is too impressive to suspect the cartographer of serious error; therefore, it is fairly certain that only since Darby's time has a channel of considerable size developed that carries water to the head of Grand Lake.

RAFT OF LOGS

A.4.2. In the area currently known as Turnbull Island near the turn of the 19th century, the meandering course of the Mississippi River

was such that the Red River flowed into the upper end of the bend. The Atchafalaya River was a distributary at the lower side of the bend and served as a great drift chute for both the Red and Mississippi Rivers.

A.4.3. The chute was choked by a mass drift, known as "the raft," which began to form about 1778 and continued to grow until 1831 when Shreve's cutoff isolated the bend in the Mississippi River. Efforts to remove "the raft" were commenced in 1839 and continued until 1855 when the obstruction was finally cleared.

DEVELOPMENT OF OLD RIVER

A.4.4. A map drawn in 1839, eight years following Shreve's cutoff, depicts rapid silting of the lower arm of Old River near its junction with the Mississippi River. No doubt, some narrowing of the abandoned channel and a great deal of shoaling also took place. By 1854-55, sizable bars had formed at the Red River's junction with the upper arm of Old River, but it was essentially open the entire distance to the Mississippi River. The lower arm, on the other hand, was closed at the point of cutoff, and a canal through the silted area was proposed by the Louisiana State Engineer. Morever, the Mississippi River had meandered considerably to the south from the original point of cutoff, so that the oxbow lake formed by Old River was almost isolated and a sharp entrance angle existed between the waters of the Red River flowing through Upper Old River and the Mississippi.

A.4.5. The Lower Old River was described as a wide, shallow, slack-water basin, receiving sediment alternately from the Mississippi and Red Rivers. By 1875 this process had nearly closed the low-water connection; and the waterway near the lower end of Turnbull's Island was only about 100 feet wide and 20 inches deep, with a fall of about 2 feet for a quarter of a mile toward the Atchafalaya. Only by extensive dredging performed by the State of Louisiana to remove a bar that formed yearly at the head of Lower Old River could a channel between the Atchafalaya and the Mississippi Rivers be maintained.

A.4.6. As the size of the Atchafalaya channel increased (due in part to raft clearance), additional amounts of Red River water were diverted down the Atchafalaya so that by 1883, considerable silting occurred in both the upper and lower arms of Old River. Had no dredging been done, the Red River (using the Atchafalaya channel) and the Mississippi River probably would have flowed in separate channels to the sea.

A.4.7. In 1891, a sill and dam were built across the old Mississippi River channel just south of the former junction of the Red and Mississippi Rivers. The purpose of the dam was to force the Red

River, when below a certain low stage, to discharge its flow through Upper Old River into the Mississippi River. The dam was sporadically maintained and finally abandoned in 1896, after which the upper arm of Old River silted up entirely. Only a series of elongated lowlands now marks its former course.

A.4.8. By 1940, dredging to maintain a channel through Lower Old River was a thing of the past as rapid natural enlargement of the channel had begun. Formerly (1882-1942), water flowed from Old River into the Mississippi River an average of 50 days of every year; but this reverse flow was recorded only 9 days between 1942 and 1950.

A.4.9. Carr Point cutoff, dredged in 1944-45, provided a shorter path for Mississippi River water diverted into Lower Old River. Shortly after this cutoff was made, the northern span of an abandoned railroad bridge, which crossed Old River about 2 miles west of its entrance into the Mississippi, fell into the rapidly enlarging river. In 1949 and 1950, revetments were placed on the Mississippi River banks upstream and downstream from Old River as the Mississippi began a rapid westward migration.

LEVEE CONSTRUCTION

A.4.10. By 1881, levees had been built by private interests along the Atchafalaya River from Simmesport downstream 26 miles on the west bank and to approximately half that distance on the east bank. In that year, levees were also built on the south side of Bayou des Glaises and Old River to channel floodwaters down the river rather than through the lowlands flanking the river. These levees were subject to general crevassing during the 1882 high water, when a discharge of 281,000 cfs is reported to have gone down the Atchafalaya. Between 1882 and 1900, levees were enlarged and extended downstream. By 1900, they flanked both sides of the river as far south as Melville, and by 1910 had been extended to Krotz Springs. Engineering data show that a rapid increase in river depth and cross-sectional area accompanied each extension of the levees.

SILL DAMS NEAR SIMMESPORT

A.4.11. By 1882, the Atchafalaya River had enlarged to such an extent that attempts were made to control its flow with brush and stone sill dams. Two dams were built just below the normal low water elevation to restrict the Atchafalaya River flow to a volume equal to the flood discharge of Red River. One was completed in 1888 in the vicinity of the present highway and railroad bridge at Simmesport; the other, completed in 1889, was approximately one-half mile downstream. These

dams were maintained until 1920, after which partial maintenance was carried on by the Louisiana Railway and Navigation Company in connection with construction of a bridge across the river in this locality. Maintenance was completely discontinued after 1934 and the dams deteriorated. Remnants of the sills that obstructed the channel were removed in 1939-40 during the dredging operations described subsequently.

DREDGING

A.4.12. Subsequent to the passage of the Flood Control Act of 1928, a program of dredging was begun in 1932 to improve the discharge capacity of the Atchafalaya River. A principal deterrent to enlargement was the tortuous maze of deltaic channels into which the river branched south of its leveed segment. Between 1932 and 1940, a single channel was dredged through this area with an overall 250-foot bottom width and a depth of 40 feet below National Geodetic Vertical Datum (NGVD).[1/] More than 100,000,000 cubic yards of earth were dredged from this portion of the river.

A.4.13. In 1938, dredging was begun in the upper, leveed segment of the Atchafalaya River, and the entrance angle at the junction of the Old, Red, and Atchafalaya Rivers was improved. The channel was enlarged at the railroad bridges that crossed the river at Simmesport, Melville, and Krotz Springs, and to a minor extent in other parts of the leveed channel. Wax Lake Outlet, a channel 15 miles long, 300 feet wide, and having a depth of 45 feet below NGVD, was completed in 1941. It provided an additional outlet for flow through the marshes south of the basin to the gulf.

A.4.14. In 1954, a systematic program was begun to accelerate maturation of the Atchafalaya River to its estimated ultimate size of 100,000 square feet in cross-sectional area. This program involved progressively increasing the confinement of ordinary flows to the main river channel, as well as dredging to increase the river cross-section to accommodate an increased flow. Results of this program closed 22 distributary streams and also increased confinement of flow by the placement of dredged material intermittently along the river banks.

[1/] Unless noted otherwise, all elevations are in fact referenced to National Geodetic Vertical Datum of 1929 (NGVD), formerly mean sea level.

No work has been done under this program since 1968, when work was suspended because the limited funds available had to be used for raising levees. In 1971, the Corps of Engineers agreed with the National Wildlife Federation to continue the suspension until an environmental impact statement had been filed. Today, under the influence of the work done between 1954 and 1968, the channel cross-section has grown to 118,000 square feet at certain locations. Between miles 54 and 100, the average cross-section is between 80,000 and 90,000 square feet. Below mile 100, where little confinement had been achieved when the program was suspended, the average channel area is only about 38,000 square feet.

The Atchafalaya Basin Floodway Project

OVERVIEW

A.4.15. Any discussion of the existing features, plans and improvements associated with the Atchafalaya Basin Floodway project must begin with the Flood Control Act of 1928, as amended. As a result of the flood which devastated the lower Mississipi River Valley in 1927, this Act authorized the comprehensive MR&T flood control project to provide flood protection in the alluvial valley of the Mississippi River between Cape Girardeau, Missouri, and Head of Passes, Louisiana. Presently, the MR&T project includes levees along the main stem of the river and its tributaries in the alluvial plain to confine floodflows; reservoirs on the tributaries to store excess floodflows; floodways and improvements to increase channel capacity, such as revetments, dikes, and dredging; and facilities, such as control structures, cutoffs, pumping plants, floodwalls, and floodgates. These features are designed to convey the project design flood discharges shown in Figure A-4-1. As can be seen by examination of the figure, the principal role of the Atchafalaya Basin Floodway System in the MR&T flood control project is to convey one half of the project design flood of 3,000,000 cfs, or 1,500,000 cfs, to the Gulf of Mexico.

A.4.16. In its early stages of development the Atchafalaya River traversed the basin via numerous small shallow channels, bayous and lakes as this natural lowland had no confining levees and only one outlet, the Lower Atchafalaya River below Morgan City. However, beginning in 1928, a series of significant modifications to the features of the basin, summarized in Tables A-4-1 and A-4-2, have been authorized by congressional action.

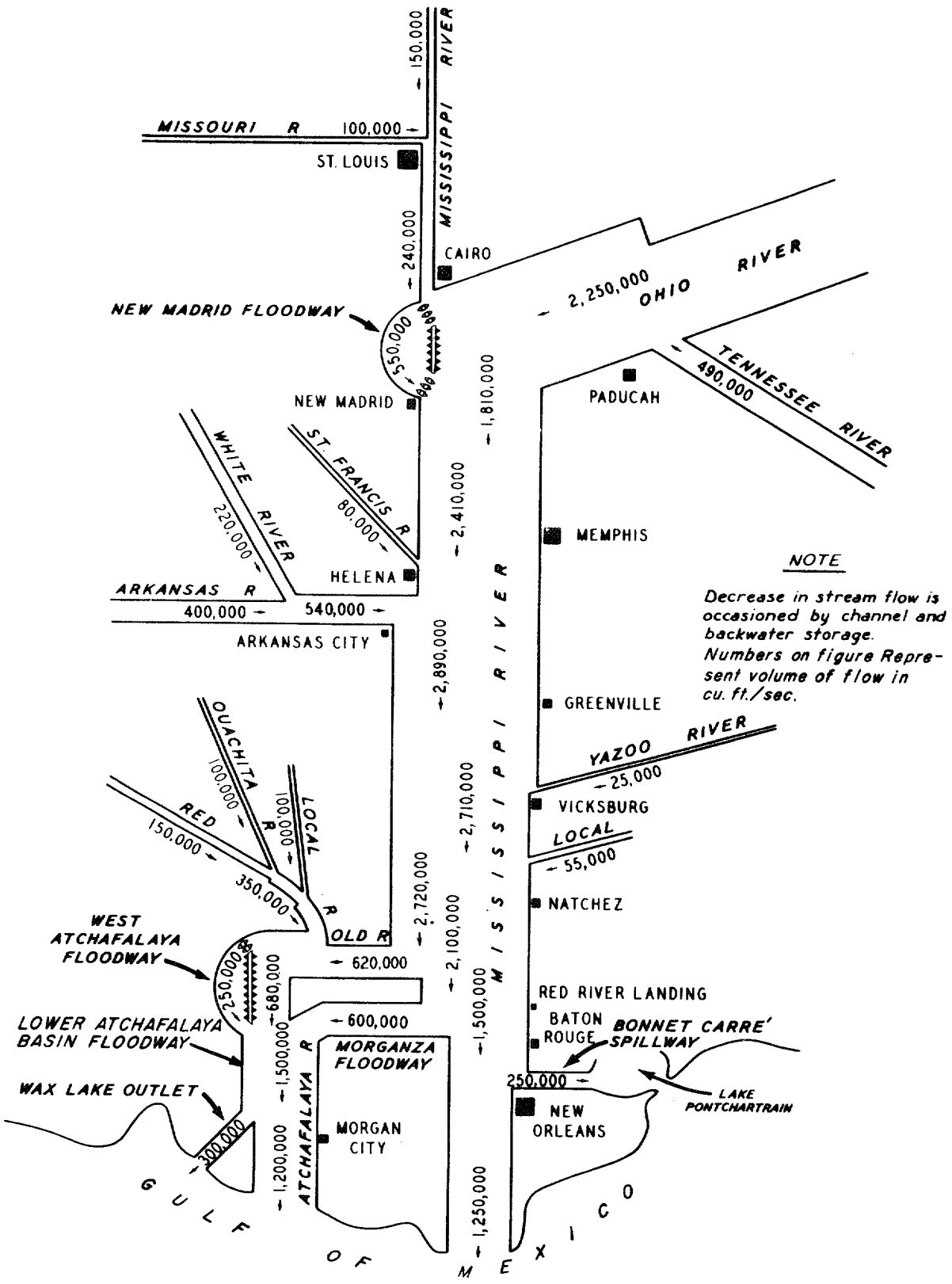

FIGURE A-4-1 PROJECT DESIGN FLOOD

TABLE A-4-1

OLD RIVER PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act of 1928 (PL 391/70)	(None)	Section 10 of the Act directs Secretary of War, through the Corps of Engineers, US Army, "to prepare and submit to Congress at the earliest practicable date projects for flood control on all tributary streams of the Mississippi River System subject to destructive floods which projects shall include:..Old River."
FC Act of 1941 (PL 288/77)	(HD 359/77/1)	Provides that the cost of right-of-way and flowage easements required for future setbacks of mainline Mississippi River levees shall be a Federal responsibility. (Confirmed by FC Act of 1944, PL 534-78). Separates maintenance requirements from construction and provides that future maintenance expenditures shall not reduce authorizations.
FC Act of 1954 (PL 780/83)	(HD 478/83/2)	Modified the Act of 15 May 1928, to include control of Old and Atchafalaya Rivers and a lock for navigation substantially as set forth in Section XIII of the MRC report, dated 2 February 1954.

TABLE A-4-1 (Continued)

OLD RIVER PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act of 1958 (PL 85/500)	(None)	Modified the Act of 15 May 1928 to include in addition to the previous authorization the sum of $28,200,000 for prosecution of the plan of improvement for the control of Old and Atchafalaya Rivers and a navigation lock approved in the Act of 3 September 1954.

HD = House Document
PL = Public Law

TABLE A-4-2

ATCHAFALAYA BASIN PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act 1928 (PL 391/70)	(HD 90/70/1)	Atchafalaya Floodway
FC Act 1928 (PL 391/70)	(CD 28/70/2)	R/W related to Bayou des Glaises setback
FC Act 1928 (PL 391/70)	(CD 28/70/2)	Atchafalaya River levee, revetment, and R/W
FC Act 1928 (PL 391/70)	(CD 28/70/2)	R/W, Atchafalaya Floodway levees
FC Act 1928 (PL 391/70)	(CD 28/70/2)	Ring levees and R/W at Simmesport, Melville, and Morgan City
FC Act 1928 (PL 391/70)	(HD 308/88/2)	Addition to ring levees
FC Act 1934 (PL 171/73)	(HR 8018)	R/W for levees
FC Act 1936 (PL 678/74)	(CD 1/71/1)	Morganza Floodway; raise in grade, Pointe Coupee levee; Atchafalaya River and Basin Improvement; Wax Lake Outlet and Charenton Canal; provide for drainage intercepted by floodway levees; roads on levees; flowage easements above Krotz Springs.
FC Act 1938 (PL 761/75)	(CD 1/75/1)	Morganza Flowage Easements
FC Act 1941 (PL 228/77)	(HD 359/77/1)	Flexibility in monetary authorization. Separates maintenance requirements from construction and provides that future maintenance expenditures shall not reduce authorizations.

TABLE A-4-2 (Continued)

ATCHAFALAYA BASIN PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act 1946 (PL 526/79)	(HD 378/74/2)	Incorporate Bayou des Glaises ditch in MR&T
FC Act 1946 (PL 526/79)	(None)	Part of $100 million for increased costs
FC Act 1954 (PL 780/83)	(None)	Part of $200 million for increased costs
FC Act 1954 (PL 780/83)	(SD 53/82)	Atchafalaya River navigation
FC Act 1962 (PL 874/87)	(None)	Flexibility in monetary authorization

CD = Congressional Document
HD = House Document
PL = Public Law
SD = Senate Document

A.4.17. As it exists today, the Atchafalaya Basin Floodway is comprised of a combination of natural characteristics and man-made elements. Project features are described in the following paragraphs and address the floodway, flood control and drainage works, and major navigation projects within the study area. The Old River control complex is not a specific feature of this project, but has been included because of its significance to and impacts on the Atchafalaya Basin Floodway.

Principal Project Features

OLD RIVER CONTROL COMPLEX

A.4.18. Flows from the Old River control complex, together with flows from Red River, form the head of the Atchafalaya River. Historically, Old River was a 7-mile stream connecting the Mississippi River with the Red and Atchafalaya Rivers. Changing conditions in Old River have been observed for the better part of a century. In 1950, a major definitive study ("The Atchafalaya River Study," published in three volumes, dated May 1951) was begun under the direction of the Mississippi River Commission to determine the possibility of the Mississippi River changing its course. The study concluded that, in the absence of man's intervention, the Mississippi River would shift to the Atchafalaya River channel through Old River, selecting this shorter course to the gulf, and that afterwards, the present lower Mississippi River would become a deep estuary cut off from freshwater flow except during major floods. As a result, the Old River project was authorized by the Flood Control Act of 1954, Public Law 780, 83rd Congress, 2nd Session, Chapter 1264, House Resolution 9859, approved 3 September 1954.

A.4.19. The primary purpose of the Old River control complex is to prevent the Mississippi River from changing its course to the Atchafalaya River. The complex controls the amount of flow from the Mississippi River into the Atchafalaya River and basin, based on 1950 conditions. Principal features of the plan consist of two mechanically-operated control structures located on the right descending bank of the Mississippi River between miles 314 and 315 above Head of Passes; an inflow channel from the Mississippi River to the low sill control structure; an outflow channel connecting the low sill control structure with Red River at about mile 10.5 above its mouth; a lock for navigation connecting the Mississippi River and the Atchafalaya and Red Rivers; forebay and tailbay channels for the lock; an earthen dam closing Old River; enlargement and extension of mainline Mississippi River levees from Shaw to Torras; and bank stabilization as required for the Old River inflow and outflow channels and for the

Red and Atchafalaya Rivers between the outflow channel and the vicinity of Simmesport. The two control structures, designated the low sill structure and the overbank structure, are intended to pass a maximum controlled discharge of 620,000 cfs at project flood conditions. To insure that capability, they were designed with a minimum capacity of 700,000 cfs at project flood conditions. Present maximum combined capacity of the structure is 850,000 cfs because of changes in headwater and tailwater conditions.

ATCHAFALAYA RIVER

A.4.20. The Atchafalaya River is the largest distributary of the Mississippi River and is the only natural intake of the Atchafalaya Basin Floodway System. The Atchafalaya River extends from its source at the junction with Old River and the Red River to Atchafalaya Bay at the Gulf of Mexico and is comprised of an upper leveed section, a middle unleveed section and a lower outlet section. The intake capacity of the Atchafalaya River presently exceeds 700,000 cfs. Through approximately the upper half of the floodway, the Atchafalaya River is confined between levees which serve to protect the lands of the Morganza and West Atchafalaya Floodways when these floodways are not in operation. On the west bank, the towns of Simmesport, Melville, and Krotz Springs are protected on the floodway side of the perimeter levees by ring levees that connect to the river levee.

WEST ATCHAFALAYA FLOODWAY

A.4.21. The West Atchafalaya Floodway (the west side intake for the Lower Atchafalaya Basin Floodway) covers an area of about 170,000 acres. This intake is bounded on the north by the Bayou des Glaises fuseplug levee, on the west by the West Atchafalaya Basin Protection Levee, and on the east by the west bank Atchafalaya River levee. The lower limit of the West Atchafalaya Floodway is approximately at the latitude of Krotz Springs. The design capacity of the West Atchafalaya Floodway is 250,000 cfs above Bayou Current and 400,000 cfs below Bayou Current.

MORGANZA FLOODWAY

A.4.22. The Morganza Floodway is the east side intake for the Lower Atchafalaya Basin Floodway and encompasses an area of 68,000 acres. Across the head of the Morganza Floodway is a massive, gated control structure almost 3/4 mile long. It is bounded on the east by the Morganza Floodway lower guide levee, which extends southwesterly from

the west bank of the Mississippi River levee near Morganza to a junction with the East Atchafalaya Basin Protection Levee at the latitude of Krotz Springs. On the north and west, it is bounded by the Morganza Floodway upper guide levee, which extends southwesterly from the west bank Mississippi River levee to a junction with the east Atchafalaya River levee near Red Cross and from there by the east Atchafalaya River levee to the latitude of Krotz Springs. Design capacity for the Morganza Floodway is 600,000 cfs.

LOWER ATCHAFALAYA BASIN FLOODWAY

A.4.23. The Lower Atchafalaya Basin Floodway covers an area about 14 miles wide by 65 miles long and extends from the latitude of Krotz Springs to the approximate latitude of Morgan City. It is bounded on the east by the East Atchafalaya Basin Protection Levee and on the west by the West Atchafalaya Basin Protection Levee. The East Atchafalaya Basin Protection Levee emanates from its intersection with the Morganza Floodway lower guide levee near Lottie and continues generally southward through Morgan City and along the Lower Atchafalaya River to Avoca Island Cutoff. The West Atchafalaya Basin Protection Levee originates near Hamburg, at its junction with the Bayou des Glaises fuseplug levee and proceeds in a southerly direction to a point south of Berwick.

LOWER ATCHAFALAYA RIVER

A.4.24. The Lower Atchafalaya River has a design capacity of 1,200,000 cfs and is the natural outlet to the Gulf of Mexico for the Atchafalaya Basin. It becomes the outlet just below Morgan City at the confluence of Berwick Bay, Bayou Shaffer and the GIWW and flows southward to Atchafalaya Bay, an approximate distance of 20 miles.

WAX LAKE OUTLET

A.4.25. The Wax Lake Outlet was constructed to improve the capability of the features of the Atchafalalya Basin project to pass floodflows to the Gulf of Mexico. This dredged channel, located about 10 miles west of Berwick, extends from Sixmile Lake through the Teche Ridge and Wax Lake into Atchafalaya Bay, a distance of about 16 miles. The channel is constructed to a bottom width of 300 feet from Sixmile Lake to a point 0.5 mile below Bayou Teche and to a bottom width of 400 feet beyond that point. It has a uniform depth of 45 feet below NGVD and a design capacity of 300,000 cfs.

Present Operation

INTAKE FLOWS

A.4.26. Flows enter the Atchafalaya Basin Floodway System through the Atchafalaya River, the Morganza Floodway and the West Atchafalaya Floodway. The actual source is dependent on the total amount of flow passing the latitude of Old River in both the Mississipi and Red Rivers. Latitude flows are distributed to the Atchafalaya and Mississippi Rivers by regulation of the Old River control complex. When the sum of the flows in the Mississippi and Red Rivers is less than 2,100,000 cfs, the structure is operated to maintain a ratio of 70 percent down the Mississippi River and 30 percent down the Atchafalaya River. The 70/30-percent flow distribution is based on the natural flow distribution that occurred in Lower Old River in 1950, and was specified in the project authorization document as the basis for the flow distribution for the Old River control complex. When the latitude flow exceeds 2,100,000 cfs, and assuming the 70/30-percent distribution, the flow in the Mississippi River below the Old River complex will approach 1,500,000 cfs, an excess of which requires the operation of the Morganza control structure and the Morganza Floodway. As latitude flow approaches 2,800,000 cfs, the design capacity of the Atchafalaya River intake (680,000 cfs) and the Morganza intake (600,000 cfs) will be attained and the West Atchafalaya Floodway may be pressed into service. However, the actual capacity of the Atchafalaya River, presently in excess of 700,000 cfs, would be utilized prior to operating the West Atchafalaya Floodway.

FLOWS WITHIN THE FLOODWAY

A.4.27. As previously stated, above the latitude of Krotz Springs, floodway flows may be conveyed in three separate conduits (Atchafalaya River, West Atchafalaya Floodway, and Morganza Floodway). These conduits are basically adequate in capacity for the design flows; however, some of the guide levees still need to be raised. Normal flows are handled entirely by the Atchafalaya River which, in this reach, generally has a leveed main channel with a cross-sectional area in excess of 100,000 square feet. The West Atchafalaya and Morganza Floodways, on the other hand, do not have a defined conveyance channel, but rather consist of wide sheet flow conduits over natural ground. Below the latitude of Krotz Springs, the three separate conduits merge into a single floodway known as the Lower Atchafalaya Basin Floodway. In this lower portion of the floodway system, the Atchafalaya River does not have a well-developed, leveed main channel. Consequently, for flows greater than 250,000 cfs, significant overbank flooding occurs below the latitude of

Krotz Springs. Due to the problems of overbank siltation and the status of levee construction in this portion of the floodway, the actual capacity is substantially lower than the floodway design capacity of 1,500,000 cfs. Additional channel enlargement and/or levee raising are required to develop the full potential of the floodway to safely pass its share of the project design flood.

OUTLET FLOWS

A.4.28. Flows conveyed through the Lower Atchafalaya Basin Floodway exit through two outlets: the Lower Atchafalaya River, the natural outlet, and Wax Lake Outlet, a man-made outlet constructed in 1942. The design conveyance capacities are 1,200,000 cfs for the Lower Atchafalaya River and 300,000 cfs for the Wax Lake Outlet. However, the actual combined capacity of the two outlets is currently only about 850,000 cfs.

Detailed Project Description

A.4.29. A detailed description of improvements associated with the Old River control complex and the Atchafalaya Basin Floodway system is provided in the following paragraphs.

OLD RIVER CONTROL COMPLEX

A.4.30. General. The principal features of the Old River control complex are the low sill structure, overbank structure, navigation lock and appurtenant channels, closures, levees, and revetments.

A.4.31. Low Sill Structure. The low sill structure is constructed of reinforced concrete and has fabricated steel control gates, an inflow channel from the Mississippi River, and an outflow channel to the Red River. The structure, built on steel piles, has a length of 566 feet between abutments and 11 gate bays, each having a 44-foot clear span between piers. The three center bays (low-flow bays) have weir crests at elevation minus 5 feet NGVD and the four outer bays on each side of the center bays have weir crests at elevation 10.0. The bays are operated by the use of vertical lift steel gates, which are opened and closed by two gantry cranes. The structure supports a 26-foot-wide highway bridge. Work was completed in 1959 and operation commenced in 1960.

A.4.32. Overbank Structure. The structure is a controlled spillway constructed of reinforced concrete with hinged timber panels for control of flows. It has a length of 3,356 feet between abutments and consists of 73 bays, each with a 44-foot clear opening between 2-foot thick piers. The crest of the concrete spillway weir is at elevation 52 feet NGVD. Fifteen timber panels, each of which is 2 feet 10.5 inches wide, are provided in each bay. The panels are hinged at the top and are raised and lowered by two gantry cranes. Construction of the overbank structure was completed in October 1959.

A.4.33. Inflow Channel - Low Sill Structure. The channel, as constructed, is 1,000 feet wide with an invert elevation of minus 5 feet NGVD and 1 vertical (V) on 4 horizontal (H) side slopes. It extends from the Mississippi River to within about 600 feet of the structure where the bottom width begins a transition to a width of 566 feet at the structure. An impervious clay blanket and riprap protection of varying thickness have been provided on the channel bottom upstream of the concrete apron. Riprap 18 inches thick has been provided on the side slopes up to elevation 48 feet NGVD for a total distance of about 600 feet upstream. This slope protection holds the alinement of and prevents meander of the approach channel. Reinforced concrete wingwalls have been provided at each corner of the structure. The inflow channel was completed in 1960.

A.4.34. Outflow Channel - Low Sill Structure. The outflow channel, as constructed, has a variable section to provide a transition from the stilling basin of the low sill structure to the design outflow channel section. The design section has a bottom width of 900 feet, 1V on 4H side slopes, and an invert elevation sloping from minus 8 feet NGVD near the structure to minus 10 feet NGVD at the junction of the outflow channel with the Red River. The bottom of the channel is protected by derrick stone and riprap for 260 feet downstream from the stilling basin. The side slopes of the channel are protected by riprap for 630 feet downstream of the end of the stilling basin. Sections of the channel in areas of readily erodible soils were dredged to pilot cross-section. The outflow channel was also completed in 1960.

A.4.35. Navigation Lock. The Old River navigation lock consists of reinforced concrete U-frame type construction, providing a usable chamber 75 feet wide by 1,200 feet long. The gates are of the horizontally framed, miter type, designed for a maximum lift of 37 feet. Filling and emptying the chamber is accomplished by means of 13-foot 6-inch square longitudinal culverts with side ports in the upper approach monolith and lock chamber and a bottom lateral discharge system in the lower approach monolith. Flow is controlled by means of individually operated segmental valves of the reversed tainter type. The Old River navigation lock was completed in 1962 and placed in operation in 1963.

A.4.36. Navigation Channel. Inflow and outflow channels for the navigation lock were completed and placed in operation in 1963. The inflow channel for the lock is approximately 2,400 feet long, 300 feet wide, and has a depth of minus 11 feet NGVD. The outflow channel is approximately 7,000 feet long, 500 feet wide, and has a depth of minus 11 feet NGVD.

A.4.37. Old River Closure. The closure dam consists of an earthen embankment constructed of sand obtained from the riverbed and of clay and silty soils obtained from an adjacent borrow area. The top of the dam is at elevation 68 feet NGVD. Its height ranges from approximately 20 feet near the bank where it connects with the levees to approximately 99 feet at the deepest part of the stream. The closure is about 1,450 feet long and has a crown width of 60 feet. Side slopes from the top of the dam down to about elevation 37 feet NGVD are 1V on 4H. Below elevation 37 feet NGVD, side slopes are 1V on 20H for about 500 feet from the centerline, then approximately 1V on 6H down to the bottom of the river. The Old River closure was completed in 1963.

A.4.38. Levees. The levees have a 10-foot crown, a net riverside slope of 1V on 4H and a net landside slope of 1V on 5.5H for net heights under 25 feet and 1V on 6H for net heights of 25 feet or more. The levee is constructed to a net grade of elevation 70 feet NGVD at Black Hawk, and generally slopes to elevation 64.2 feet NGVD at the point where it connects with the levee along the south bank of Lower Old River. Construction of levees is complete. Additional levee construction will be required in connection with the planned auxiliary structure.

A.4.39. Revetment. Stone and articulated concrete revetments are being constructed as required in the inflow and outflow channels of the control structures and along the Red and Atchafalaya Rivers between the outflow channel of the low sill structure and the vicinity of Simmesport to control meandering of the main channels as a result of construction of the control structures. These works are surveyed periodically to assure that they are in place and that repairs are made as required. Additional revetment work will be required in connection with the construction of the auxiliary structure.

A.4.40. Auxiliary Structure. The construction of an auxiliary control structure to supplement the existing low sill structure began in July 1981 and is scheduled for completion in late 1985. As presently designed, the auxiliary structure is of reinforced concrete and has six 62-foot-wide gate bays with a sill elevation of minus 5.0 feet NGVD with steel tainter-type gates for control. About 15,000 feet of conveyance channel and 22,000 feet of levee will be constructed. The need for an auxiliary structure is discussed in Section 7 of this appendix.

ATCHAFALAYA BASIN FLOODWAY SYSTEM

A.4.41. The Atchafalaya Basin Floodway system, exclusive of Old River control complex, is shown in Plate A-2. The project features associated with the floodway system are listed in Table A-4-3 and are described in subsequent paragraphs of this section.

ATCHAFALAYA BASIN FLOODWAY SYSTEM LEVEES

A.4.42. General. The Atchafalaya Basin Floodway system has 449.2 miles of levee, 213.1 miles of which have been found to be deficient after the project flowline was adjusted upward after the 1973 flood. Major deficiencies are on the East and West Atchafalaya Basin Protection Levees. Much of the levee system west of Berwick, which provides protection from backwater flooding, is also deficient, although to a lesser degree than the protection levees. The East Atchafalaya Basin Protection Levee, from a point about 7 miles below the Morganza control structure (on the Morganza Floodway lower guide levee) to the end of the Avoca Island levee, and the West Atchafalaya Basin Protection Levee, from US Highway 190 to its end below Berwick, are considered deficient with respect to the new flowline. Minor deficiencies also exist on the Mansura Hills to Hamburg levee and the west Atchafalaya River levee. Planning, design, and construction to upgrade the levees to required standards is underway. Overall completion is scheduled for 1997.

A.4.43. The description and total length of the levees and floodwalls in the system are shown in Table A-4-4.

A.4.44. The Morganza Floodway Levees. These levees consist of the upper and lower guide levees which, with the east Atchafalaya River levee, form a floodway averaging about 5 miles wide. The upper guide levee extends 8.9 miles southwesterly from the combined control structure to the east Atchafalaya River levee about 2 miles upstream from Melville. This levee protects more than 100 square miles of farmlands in upper Pointe Coupee Parish from overflow during floodway operations. The lower guide levee extends about 19.5 miles in a southerly direction from the control structure to join the East Atchafalaya Basin Protection Levee at the latitude of Krotz Springs. The levees are maintained by local interests. Maintenance includes mowing and inspection for caving and loss of cross-section. The upper guide levee is complete, whereas the lower guide levee requires improvement to provide adequate protection against a project design flood.

A.4.45. The East Atchafalaya Basin Protection Levee. The East Atchafalaya Basin Protection Levee begins at the lower end of the lower guide levee of the Morganza Floodway and extends southward

TABLE A-4-3

ATCHAFALAYA BASIN FLOODWAY SYSTEM PROJECT FEATURES

No.	Description
	LEVEES AND FLOODWALLS
1	Morganza Floodway guide levees
2	East Atchafalaya Basin Protection Levee
3	West Atchafalaya Basin Protection Levee
4	Atchafalaya River levees
5	Bayou des Glaises fuseplug levee
6	Mansura Hills to Hamburg levee
7	Levees west of Berwick
	FLOOD CONTROL STRUCTURES
8	Morganza combined control structure
	NAVIGATION WORKS
9	Atchafalaya River channel
10	Bayou Sorrel lock
11	Charenton floodgate and bridge
12	Calumet floodgates (2)
13	Berwick lock
14	Bayou Boeuf lock
15	Rerouting GIWW below Morgan City
16	East access channel
17	West access channel
	CHANNEL IMPROVEMENT
18	Enlargement dredging (mile 0 to mile 54)
19	Distributary closures
20	Enlargement dredging (mile 54.5 to mile 112.3)
21	Revetments
	DRAINAGE IMPROVEMENTS (POINTE COUPEE)
44	Enlargement of Bayou Latenache
45	Enlargement of Morganza upper guide levee borrow pit
46	Pointe Coupee drainage structure
	Pointe Coupee pumping station
	OTHER DRAINAGE
47	Drainage improvements west of Berwick
48	Wax Lake Outlet
49	Lower Atchafalaya River
	IMPROVEMENTS FOR ACCESS, FISH AND WILDLIFE, AND RECREATION
50	Dredge material retaining dikes
51	Roads on levees
52	Public Use areas

TABLE A-4-3 (Continued)

ATCHAFALAYA BASIN FLOODWAY SYSTEM PROJECT FEATURES

No.	Description
	IMPROVEMENTS FOR ACCESS, FISH AND WILDLIFE, AND RECREATION (Continued)
16	East access channel
17	West access channel
53	East freshwater distribution channel
54	West freshwater distribution channel
55	East freshwater distribution structure
56	West freshwater distribution structure
	FLOWAGE EASEMENTS
57	Below Krotz Springs
58	West Atchafalaya Floodway
59	Morganza Floodway
60	Morgan City front
61	Bayou des Glaises loop
62	Bayou Chene
	DRAINAGE IMPROVEMENTS (WABPL)
22	Bordelonville-Hamburg levee drainage
23	Bayou des Glaises culvert
24	State Canal-Bayou Roseau drainage canal
25	Hamburg-Palmetto interceptor ditch
26	Bayou des Glaises diversion channel
27	Brushy Bayou Drainage structure
28	Brushy Bayou enlargement
29	Hamburg to Courtableau borrow pit
30	Bayou Darbonne drainage structure and channels
31	Bayou Courtableau diversion structure and channels
32	Bayou Courtableau drainage structure and channels
33	Bayou Berard drainage canal
34	Opelouses Bay to Lake Larose channel
35	Cypremont-Dauterive channel improvement
11	Charenton floodgate
36	Charenton drainage canal
37	Melville culverts
	DRAINAGE IMPROVEMENTS (EABPL)
38	Bayou Gerance drainage ditch
39	Lottie to Bayou Maringouin borrow pit
40	Bayou Boeuf-Bayou Long channel
41	Bayou Chene channel improvement
42	Tiger Island pumping plant
43	Front Street pumping plant

TABLE A-4-3 (Continued)

ATCHAFALAYA BASIN FLOODWAY SYSTEM PROJECT FEATURES

No.	Description
	RELOCATIONS AND ALTERATIONS
63	US 190 high level crossing
64	N.O.T. & M. railroad high level crossing
65	Ville Platte–Opelousas railroad connection
66	T. & P. railroad crossing at Melville
67	Gulf States Utilities powerline crossing
68	Raising Berwick Bay bridges
69	La. Hwy. 129 (La. 87) at Charenton Canal
70	US Hwy. 90 bridge at Charenton Canal
71	Southern Pacific railroad bridge at Charenton
72	La. & Ark. railroad bridge at Simmesport
73	N.O.T. & M. railroad bridge at Krotz Springs
74	US Hwy. 90 bridge at Wax Lake Outlet
75	Southern Pacific railroad bridge at WLO
76	La. Hwy. 1 at Morganza
77	T. & P. railroad at Morganza
78	Numerous pipelines, powerlines, etc.
79	T. & P. railroad, adjustment of track & fac.
	MAINTENANCE DREDGING
80	Maintenance dredging

TABLE A-4-4

LEVEES AND FLOODWALLS

Description	Total Length [1]	Deficient Length [1]	Completed Length [1]
Morganza Floodway guide levees:			
Upper guide levee	8.9	-	8.9
Lower guide levee	19.5	19.5	-
East Atchafalaya Basin Protection Levee:			
Levees and Floodwalls	87.2	64.2	23.0
West Atchafalaya Basin Protection Levee:			
Levees and Floodwalls	128.7	78.0	50.7
Atchafalaya River levees:			
East Atchafalaya River levee	52.5	-	52.5
West Atchafalaya River levee	60.1	4.5	55.6
Simmesport ring levee	1.6	-	1.6
Melville ring levee	4.1	-	4.1
Krotz Springs ring levee	1.7	-	1.7
Bayou des Glaises fuseplug levee	7.9	-	7.9
Mansura Hills to Hamburg levee	20.5	-	20.5
Levees west of Berwick	56.5	46.9	9.6
TOTAL	449.2	213.1	236.1

[1] Length in miles.

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through Morgan City to Avoca Island Cutoff and includes Bayou Sorrel and Bayou Boeuf locks. The length of this system is 87.2 miles, including about 15.5 miles of floodwall above Morgan City, 1.3 miles of floodwall along Morgan City front, and about 0.4 mile of floodwall below Morgan City. About 64.2 miles of this levee and floodwall are deficient and require additional work.

A.4.46. The West Atchafalaya Basin Protection Levee. The West Atchafalaya Basin Protection Levee begins near the town of Hamburg where it joins the Bayou des Glaises fuseplug levee. The levee extends in a south-southeasterly direction to Wax Lake Outlet at the latitude of the east and west Calumet floodgates, then eastward through Berwick and to the GIWW below Berwick. It covers 128.7 miles and includes 0.9 mile of floodwall along the front of the town of Berwick. Structures along the levee include Bayou Darbonne and Courtableau drainage structures, the Charenton floodgate, the east and west Calumet floodgates, and the Berwick lock, all of which are described subsequently.

A.4.47. The East Atchafalaya River Levee. This levee extends from the junction of the Atchafalaya, Old, and Red Rivers along the east bank of the Atchafalaya River to new Alabama Bayou, a distance of 52.5 miles. The levee is complete.

A.4.48. The West Atchafalaya River Levee. This levee extends southward from the Bayou des Glaises fuseplug levee at Simmesport along the west bank of the Atchafalaya River and Butte La Rose to Bayou Garofier, a distance of 60.1 miles. It also includes the Simmesport ring levee, 1.6 miles in length, and its drainage outlet, Brushy Bayou drainage structure; Melville ring levee, 4.1 miles in length, and its drainage structures; and the Krotz Springs ring levee, 1.7 miles in length. Total length of levee in this system is 67.5 miles. The levee is complete except for minor deficiencies along approximately 4.5 miles.

A.4.49. The Bayou des Glaises Fuseplug Levee. The Bayou des Glaises fuseplug levee extends from the town of Simmesport west and along the south bank of Bayou des Glaises to the West Atchafalaya Basin Protection Levee near Hamburg, a distance of 7.9 miles. This levee protects the lands in the West Atchafalaya Floodway from floodwaters in the Mississippi-Red River backwater area until stages requiring the use of the West Atchafalaya Floodway are reached. Floodwaters will then enter the floodway by natural and/or artificial crevassing of the levee. The Red River, Atchafalaya, and Bayou Boeuf Levee District is responsible for maintenance. Primarily, maintenance includes mowing and inspection for levee caving and loss of cross-section.

A.4.50. The Mansura Hills to Hamburg Levee. This feature extends from the Mansura Hills, along the north bank of Bayou des Glaises to the state-owned drainage structure (Bordelonville floodgate) in Bayou

des Glaises, across the structure and southward to the junction of the West Atchafalaya Basin Protection Levee and the Bayou des Glaises fuseplug levee near the town of Hamburg, a distance of 20.5 miles. This levee serves as protection for the area west of the floodways and west of Marksville from the Mississippi-Red River backwaters but it is slightly deficient throughout its length. The Red River, Atchafalaya, and Bayou Boeuf Levee District is responsible for maintenance. Primarily, maintenance includes mowing and inspection for levee caving and loss of cross-section.

A.4.51. The Levees West of Berwick. These levees consist of approximately 56.5 miles of intermittent levees, tying into high ground. They have been designed to protect the lands along the Teche and Sale Ridges from the backwaters created by diversion of floodwaters from the Mississippi and Red Rivers through the floodways, the Wax Lake Outlet, and the Lower Atchafalaya River.

A.4.52. The levee system begins at the lower end of the West Atchafalaya Basin Protection Levee below Berwick and extends generally westward along the north bank of the GIWW and east bank of Wax Lake Outlet, to the east Calumet floodgate. It continues on the opposite side of Wax Lake Outlet at the west Calumet floodgate, following a southerly and westerly direction along Wax Lake Outlet and the north bank of the GIWW to high ground at Bayou Sale, then follows along an irregular alinement around the Bayou Sale Ridge below the GIWW and northward above the GIWW to the Charenton Drainage Canal near Baldwin.

A.4.53. The levee system in this reach is maintained by the St. Mary Parish Police Jury. Primarily, maintenance includes mowing and inspection for levee caving and loss of cross section.

A.4.54. Morgan City to Tiger Island Improvements. Project features include levees, floodwalls, two pumping stations, and drainage culverts for the protection of Morgan City and areas to the east during high water stages in the Lower Atchafalaya Basin Floodway. Improvements north of the Southern Pacific Railway consist of approximately 213 linear feet of levee, 6,661 linear feet of reinforced concrete floodwall, and 1,600 linear feet of reinforced concrete box and pipe storm sewer. The improvements in the area south of the Southern Pacific Railroad, known as "Tiger Island," consist of approximately 8,180 linear feet of levees, 1,990 linear feet of floodwalls, a pumping station, 2,500 linear feet of corrugated metal pipe storm sewer, and drainage culverts with flap and sluice gates. A new floodwall through this entire area is required to protect against the higher flowline grades.

A.4.55. The Berwick Levee and Floodwall. This feature is located along the banks of Berwick Bay and the Lower Atchafalaya River fronting the city of Berwick in St. Mary Parish. The protective works consist of 1.6 miles of earthen levee and 0.9 mile of reinforced

concrete floodwall with gates at street intersections and pedestrian crossings, and a drainage structure to provide gated protection for a storm sewer that passes through the floodwall. Due to the higher flowline grades a new floodwall along the Berwick front is planned. The existing levee in this reach must also be raised and enlarged or a floodwall constructed to conform to standard requirements.

A.4.56. Construction of existing project features was completed in 1951 and operation and maintenance are local interest responsibility. Maintenance by local interests includes mowing and inspection for levee caving and loss of cross-section. Materials are stored for use in closing access gaps through the floodwall and for repairing minor structural cracks.

FLOOD CONTROL STRUCTURES

A.4.57. The Morganza Control Structure. This structure consists of about 19,340 linear feet of levee and a reinforced concrete structure having 125 gated openings, each 28 feet 3 inches wide, separated by 3-foot-wide piers. Each opening is equipped with a steel vertical-lift gate operated by a gantry crane. Bridges for the gantry crane, for LA Highway 1, and for the joint track for the Kansas City Southern and Texas and Pacific Railways are also supported on the structure piers. The earthen embankment on each side of the control structure also serves to carry the highway and railroads across the floodway. Design capacity for the structure is 600,000 cfs.

NAVIGATION WORKS

A.4.58. Descriptive data on navigation works associated with the Atchafalaya Basin Floodway system are presented in Table A-4-5 and are discussed in subsequent paragraphs.

A.4.59. Atchafalaya River Channel. This channel, 12 feet deep over a bottom width of 125 feet, extends from the GIWW at Morgan City to the Mississippi River via the Atchafalaya and Old Rivers.

A.4.60. Bayou Sorrel Lock. The Bayou Sorrel lock consists of two reinforced concrete gate bays equipped with steel sector gates and connected with an earthen chamber having a timber guide wall on each side. The length is 800 feet, the clear width is 56 feet, and the sill elevation is minus 14 feet NGVD. The lock provides for navigation through the East Atchafalaya Basin Protection Levee as a part of GIWW Morgan City to Port Allen alternate route.

TABLE A-4-5

NAVIGATION WORKS

Description	Usable Length (ft)	Length	Width (ft)	Depth (ft NGVD)	Date Completed
Atchafalaya Basin navigation channel		116 miles	125	-12.8	Feb 56
Bayou Sorrel lock	790	800 feet	56	-14.0	Oct 52
Charenton floodgate		175 feet	45	-10.8	Jul 48
Floodgate bridge		45 feet		1/	Mar 51
Calumet floodgates (2 each)		161 feet	45	-9.8	Sep 50
Berwick lock	300	307 feet	45	-9.8	Nov 50
Bayou Boeuf lock	1148	1,158 feet	75	-13.8	Jun 54
Rerouting GIWW below Morgan City		10.1 miles	125	-12.8	2/
East access channel		12.1 miles	80	-7.0	Nov 66
West access channel		11.6 miles	80	-7.0	Aug 67

1/ Low steel of bridge at 20.7 feet NGVD.
2/ Incomplete.

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A.4.61. Charenton Floodgate and Bridge. This floodgate is a reinforced concrete structure 175 feet long with a clear width of 45 feet, a bottom elevation of minus 10.8 feet NGVD with steel sector gates. The floodgate provides for release of intercepted drainage into the Atchafalaya Basin Floodway and also for navigation through the West Atchafalaya Basin Protection Levee. A removable bridge with a low steel elevation of 20.7 feet NGVD has been constructed across the structure.

A.4.62. East and West Calumet Floodgates. Each floodgate is a reinforced concrete structure 161 feet long with a 45-foot clear width, a sill elevation of minus 9.8 feet NGVD with steel sector gates. These floodgates provide for drainage of waters from Bayou Teche and for navigation through the Wax Lake Outlet guide levees.

A.4.63. Berwick Lock. This lock is a 45-foot wide reinforced concrete structure which has a sill elevation of minus 9.8 feet NGVD and a usable length of 300 feet between steel sector gates. The lock provides for navigation between Bayou Teche and the Lower Atchafalaya River, through the West Atchafalaya Basin Protection Levee.

A.4.64. Bayou Boeuf Lock. This lock consists of two reinforced concrete gate bays equipped with steel sector gates connected by an earthen chamber that has a timber guide wall on one side. The lock has a length of 1,156 feet, a clear width of 75 feet, a sill elevation of minus 13.8 feet NGVD and provides for navigation in Bayou Boeuf through the East Atchafalaya Basin Protection Levee.

A.4.65. Rerouting GIWW below Morgan City. This feature provides for rerouting the GIWW around and below Morgan City, through Bayou Chene and the Lower Atchafalaya River, thereby bypassing the existing Bayou Boeuf lock.

A.4.66. East and West Access Channels. This feature consists of channels, minus 7.0 feet NGVD by 80 feet, which provide navigable connections between the east and west Atchafalaya guide levees. An additional function of these channels is to distribute freshwater to the overbank areas they traverse.

A.4.67. Enlargement Dredging (Barbre Landing to Alabama Bayou). This feature consists of improving the discharge capacity of the leveed channel of the Atchafalaya River (mile 0 to mile 54) by the enlargement of restricted sections of the channel, including the enlargement and alteration of existing railroad and highway bridges that may be required.

A.4.68. Distributary Closures. This feature provides for closures of distributary channels to facilitate development of the main channel through the lower basin. Closure construction consists of embankments built with locally available clay placed by hydraulic dredge. The closures constructed to date are shown in Table A-4-6.

TABLE A-4-6

DISTRIBUTARY CLOSURES

Location (River mile)	Closure Name	Date Completed
54.5 L	Alabama Bayou	Nov 1954
55.8 L	Bayou Des Ourses	Nov 1954
58.4 R	Unnamed	Oct 1956
59.5 L	Bayou des Glaises	Oct 1956
63.7 R	Upper Grand River	Feb 1963
66.7 R	Big Tensas Bayou	Jun 1956
67.8 L	Upper Grand River	Jun 1956
70.5 R	Logan Chute	Aug 1963
74.5 R	Lake Mongoulois	May 1962
76.5 L	Jakes Bayou (lower end)	Oct 1959
78.7 L	Little Coon Trap Bayou	Oct 1959
79.6 L	Lake Chicot	Oct 1959
83.9 R	West Fork Chicot Pass	Oct 1959
85.2 R	Oil Company Canal	Aug 1959
86.9 R	Unnamed	Aug 1959
90.5 R	Unnamed	Feb 1961
91.7 R	Unnamed	Feb 1961
92.5 L	Shell Bayou	Feb 1961
93.8 R	Unnamed	Feb 1961
94.1 R	Unnamed	Feb 1961

A.4.69. Enlargement Dredging (below Whiskey Bay). This feature consists of dredging a continuous deep main channel through the central portion of the Atchafalaya Basin, extending from the Atchafalaya River at Alabama Bayou (mile 54.5) through the basin into the main body of Grand Lake (mile 112.3). Work completed to date is shown in Table A-4-7.

A.4.70. Revetments. The revetment program provides for revetments to stabilize the channel of the Atchafalaya River, primarily in the leveed reach of the river. Details on the revetments are shown in Table A-4-8.

DRAINAGE IMPROVEMENTS

A.4.71. Drainage Improvements Associated with the East Atchafalaya Basin Protection Levee. These improvements are shown in Table A-4-9 and are described subsequently.

- Bayou Gerance Drainage Ditch.

- Lottie to Bayou Maringouin Borrow Pit Enlargement. This consists of the enlargement of the restricted sections of the landside borrow pit, beginning at a point one-quarter mile south of Lottie and continuing to Bayou Maringouin.

- Bayou Boeuf-Bayou Long Drainage Canal. This canal features the improvement of existing streams along the landside of the East Atchafalaya Basin Protection Levee from the Bayou Sorrel lock to the vicinity of Lake Palourde, a new landcut around the east side of Lake Palourde to Bayou Boeuf, and the enlargement of Bayou Boeuf to provide a minimum channel 9 feet by 100 feet for drainage and navigation from the GIWW to the levee borrow pit.

- Bayou Chene Channel Improvement. This improvement to restricted sections of Bayou Chene provides a minimum channel 9 feet by 100 feet for drainage.

- Tiger Island Pumping Plant. This provides for interior drainage at Morgan City.

- Front Street Pumping Plant. This provides for interior drainage at Morgan City.

A.4.72. Drainage Improvements Associated with the West Atchafalaya Basin Protection Levee. These improvements are shown in Table A-4-10 and are described subsequently.

TABLE A-4-7

ENLARGEMENT DREDGING

Location (River mile)		Completed Channel Size (ft^2)	Volume Dredged (cu. yds.)	Completed [1/]
54.5 - 60.6	Whiskey Bay Pilot Channel	60,000	14,069,000	Sep 62
60.6 - 63.7	Whiskey Bay Pilot Channel	60,000	12,954,000	Feb 63
63.7 - 67.8	Upper Grand River	60,000	9,548,000	Jul 66
67.8 - 70.5	Blind Tensas Cut	60,000	15,126,000	Aug 63
70.5 - 76.0	Lake Mongoulois-Bayou Chene Cut and Tarlton Bayou	60,000	18,510,000	May 66
76.0 - 80.2	Tarlton Bayou, Bayou Chene and Chicot Pass	60,000	21,192,000	Dec 66
80.2 - 85.1	Chicot Pass	60,000	29,430,000	Dec 66
85.1 - 91.0	Chicot Pass	60,000	40,042,000	May 64
91.0 - 96.2	Chicot Pass and Grand Lake	60,000	30,408,000	May 64
96.2 - 103.4	Grand Lake and Cypress Pass	40,000	22,164,000	May 66
103.4 - 112.3	Cypress Pass and Sixmile Lake	40,000	24,860,000	Feb 68

[1/] Additional work is planned; enlargement discontinued in 1968 due to lack of funding and discontinued since 1971 pending filing of an Environmental Impact Statement with Environmental Protection Agency.

TABLE A-4-8
REVETMENTS

Location (River mile)		Revetment Name	Required	Completed	Uncompleted 1/	Date Completed 2/
4.0	L	Legonier	2.3	1.7	0.6	1973
5.5	R	Simmesport	2.4	2.0	0.4	1970
7.5	L	Kuhlman Bayou	1.1	1.1	-	1975
8.0	R	Odenburg	1.5	1.0	0.5	1974
10.0	L	Jacoby	1.7	-	1.7	-
12.5	R	Cason	1.5	-	1.5	-
13.5	L	McCrea	1.3	1.0	0.3	1974
14.5	R	Woodside	3.1	2.5	0.6	1974
17.0	L	Provosty	2.0	1.5	0.5	1969
18.5	R	Crooked Bayou	2.1	1.8	0.3	1969
21.5	L	Mercier	2.9	1.6	1.3	1972
23.5	R	Barberton	0.9	-	0.9	-
24.0	L	Evans Point	1.3	0.5	0.8	1971
25.5	R	Goudeau	1.0	0.7	0.3	1974
26.5	L	Morris Bayou	1.2	0.7	0.5	1972
27.5	R	Goodwood	1.3	0.8	0.5	1970
28.5	L	Red Cross	1.6	0.0	1.6	-
29.5	R	Melville	1.5	0.9	0.6	1972
31.0	L	Cross Bayou	1.3	0.7	0.6	1974
32.0	R	Melville South	1.9	0.8	1.1	1972
34.6	L	Toles	2.0	1.2	0.8	1970
35.5	R	Petite Prairie	1.4	1.0	0.4	1975
37.0	L	Holloway Lake	1.1	1.1	-	1974
38.0	R	Three Mile Bayou	0.7	0.0	0.7	-
38.5	L	Bayou Sherman	0.8	0.0	0.8	-
40.5	R	Krotz Springs	2.8	0.9	1.9	1973
43.5	L	East Krotz Springs	1.4	0.0	1.4	-
44.5	R	Sherburne	1.8	1.3	0.5	1974
48.0	L	Bayou Big Graw	3.0	0.0	3.0	-
48.5	R	Caswell Bayou	1.1	0.0	1.1	-
50.0	L	Courtableau Bayou	1.2	0.0	1.2	-
52.0	R	Alabama Bayou	1.5	0.0	1.5	-
53.0	L	Indian Bayou	1.5	0.0	1.5	-
54.0	R	Happytown	1.3	0.0	1.3	-
115.0	L	Otis Landing	1.1	0.0	1.1	-
		Morgan City Front	1.4	0.6	0.8	1967
		TOTALS	58.0	25.4	32.6	

1/ Length in miles.
2/ Date work in place completed.

TABLE A-4-9

DRAINAGE IMPROVEMENTS ASSOCIATED
WITH THE EAST ATCHAFALAYA BASIN PROTECTION LEVEE

Description and Location	Pertinent Data	Date Completed
Bayou Gerance drainage ditch		Jun 39
Lottie to Maringouin borrow pit	Consists of enlargement of the restricted section of the landside borrow pit between a point one-quarter mile south of Lottie and Maringouin.	Feb 40
Bayou Boeuf-Bayou Long Channel	Consists of the improvement of existing streams along the landside East Atchafalaya Basin Protection Levee from the Bayou Sorrel lock to the vicinity of Lake Palourde, a new land cut around the east side of Lake Palourde to Bayou Boeuf, and the enlargement of Bayou Boeuf to 9 feet by 100 feet for drainage and navigation.	Jun 47
Bayou Chene channel improvement	Provides for enlargement of restricted (9 feet by 100 feet) sections of Bayou Chene to provide a 9 feet by 100 feet channel for drainage and navigation.	Jun 47
Tiger Island pumping plant	Consists of three pumps with a total capacity of 138 cfs at 5.0 feet head.	May 55
Front Street pumping plant	Original plant consisted of two pumps with a capacity of 35 cfs at 16.0 head. One pump has been replaced and present capacity is 58 cfs.	

TABLE A-4-10

DRAINAGE IMPROVEMENTS ASSOCIATED WITH
THE WABPL

Description and Location	Pertinent Data	Date Completed
Bordelonville-Hamburg levee drainage		Apr 1943
Bayou des Glaises culvert, near Hamburg	72-inch diameter CMP, approx. 200 ft long, w/concrete stilling basin	Dec 1938
State Canal-Bayou Roseau drainage canal, near Hamburg	25-foot bottom width, variable depth	Aug 1945
Hamburg-Palmetto interceptor ditch, (floodway side)		Aug 1938
Bayou des Glaises diversion channel, near Moreauville		Sep 1938
Brushy Bayou drainage structure, near Simmesport	Reinforced concrete box culvert, 5 ft x 6 ft., approx. 185 ft. long, with steel headgate	Dec 1947
Brushy Bayou enlargement, near Simmesport		May 1942
Hamburg to Courtableau borrow pit, (landside of WABPL)		May 1939
Bayou Darbonne drainage structure and channels, near Port Barre	Reinforced concrete box culvert, 1 barrel, 10 ft x 10 ft. x 265 ft. with gate	Feb 1941
Bayou Courtableau diversion structure (2 weirs) and channels	Reinforced concrete weirs, 2 each, crest at 18.0 ft. NGVD, length 503 ft.	May 1942
Bayou Courtableau drainage structure and channels, near Port Barre	Reinforced concrete box culvert, 5 barrels, 10 ft. x 15 ft. x 220 ft. with gates	May 1956
Bayou Berard drainage canal, (landside)		Mar 1940
Opelousas Bay to Lake Larose channel (floodway side)		Oct 1948
Cypremont-Dauterive channel improvement, (landside borrow pit)	75 ft. bottom width, -15.0 NGVD bottom elevation, approx. 14.3 miles	Feb 1941
Charenton floodgate, near Charenton	Reinforced concrete navigable floodgate, 45 ft. x -10.8 ft. NGVD x 175 ft.	Jul 1948
Charenton drainage canal, from Lake Fausse Pointe to Gulf of Mexico	75 ft. x -30.0 NGVD x approx. 15 miles	Sep 1948 1/
Melville culverts, at Melville	72-inch diameter CMP (2 each), approx. 225 ft. long, with gates	Sep 1948

1/ Original channel completed Apr 1940, enlargement completed Sep 1948.

• Bordelonville-Hamburg Levee Drainage. This improvement consists of a drainage ditch parallel to the lower portion of the Mansura Hills to Hamburg levee, which drains the interior of the Bayou des Glaises loop.

• Bayou des Glaises Culvert. This structure consists of a 72-inch corrugated pipe culvert with flap gate and concrete stilling basin. The culvert passes through the old Bayou des Glaises levee (non-Federal), connecting the floodway side borrow pit of the Bordelonville-Hamburg levee with Bayou des Glaises proper, and providing an outlet for the water accumulating within the Bayou des Glaises loop.

• State Canal - Bayou Roseau Drainage Canal. This improvement consists of an enlarged channel to take off some landside drainage intercepted by the Mansura Hills to Hamburg levee.

• Hamburg-Palmetto Interceptor Ditch. This improvement provides drainage along the floodway side of the West Atchafalaya Basin Protection Levee between Hamburg and the state drainage canal.

• Bayou des Glaises Diversion Channel. This channel connects Bayou des Glaises with the landside borrow pit of the West Atchafalaya Basin Protection Levee.

• Brushy Bayou Drainage Structure. This improvement consists of a 5-foot by 6-foot reinforced concrete structure that provides drainage from the interior of the Simmesport ring levee into the West Atchafalaya Floodway.

• Brushy Bayou Enlargement. This consists of enlargement and improvement of Brushy Bayou and Yellow Bayou to provide an outlet from the Brushy Bayou drainage structure to the state drainage canal (non-Federal).

• Hamburg to Courtableau Borrow Pit Enlargement. This improvement consists of enlarging inadequate sections of the existing borrow pit.

• Bayou Darbonne Drainage Structure. This structure consists of a reinforced concrete box culvert, 10 feet by 10 feet by 265 feet long, with a manually-controlled gate. It is located in the West Atchafalaya Basin Protection Levee at the Bayou Darbonne crossing.

• Bayou Courtableau Diversion Structure and Channels. These improvements consist of two wide, shallow, reinforced concrete weirs with crests of 18.0 feet above NGVD and widths of 503 feet, constructed on the south bank of Bayou Courtableau. The outlet channels connect to the West Atchafalaya Basin Protection Levee borrow pit south of the weirs.

• Bayou Courtableau Drainage Structure and Channels. These improvements consist of a reinforced concrete box-type culvert with five barrels (each 10 feet by 15 feet and 220 feet long), with five mechanically-operated vertical lift gates at the outlet end; an inlet channel approximately 1,800 feet long with a bottom width of 100 feet and 1V on 2H side slopes; an outlet channel approximately 23,500 feet long with a bottom width of 120 feet and side slopes 1V on 3H; a 1,300-foot levee along the south bank of the inlet channel with a 12-foot-wide gravel road on the crown; and guide levees on both banks of the outlet channel (constructed from disposal material) for confining drainage flows passed through the structures.

• Bayou Berard Drainage Canal. This canal extends from the landside borrow pit in the vicinity of Cypremont, about 3 miles below Henderson Lake, to the head of Lake Catahoula, a distance of 7 miles. The Bayou Berard drainage canal has a bottom width of 65 feet, 15 feet below NGVD.

• Opelousas Bay to Lake Larose Channel. This consists of a channel connecting the lower (south) end of Opelousas Bay with Bayou LaRose.

• Cypremont-Dauterive Channel Improvement. This channel extends in a southerly direction in the landside borrow pit, beginning about 1 mile south of Cypremont and ending opposite the head of Lake Dauterive, a distance of 14.3 miles.

• Charenton Floodgate. This is a reinforced concrete structure 175 feet long with a clear width of 45 feet, a bottom 10.8 feet below NGVD, and steel sector gates. A removable bridge with a low steel elevation of 20.7 feet NGVD, exists across the structure.

• Charenton Drainage Canal. This is a drainage connection that begins at Lake Fausse Pointe, extends through the landside borrow pit of the West Atchafalaya Basin Protection Levee to the Charenton floodgate, through a landcut to Bayou Teche near Charenton, then extends along Bayou Teche to a point near Baldwin, through a landcut to West Cote Blanche Bay, an arm of the Gulf of Mexico. The canal has a bottom width of 75 feet, 30 feet below NGVD, and a design discharge capacity of approximately 22,000 cfs.

• Melville Culverts. These consist of two gated corrugated metal culverts, which provide drainage from the interior of the Melville ring levee to the West Atchafalaya Basin Floodway. Each culvert is 72 inches in diameter and is equipped with a steel lift gate on the floodway side.

A.4.73. Drainage Improvements Associated with Pointe Coupee Loop. These include the following:

- Pointe Coupee Drainage Structure. An existing drainage system for the upper Pointe Coupee Parish area, which is protected by the upper guide levee of the Morganza Floodway, was provided with construction of the Point Coupee Drainage Structure at the intersection of the levee and Bayou Latenache and the enlargement of the bayou from the structure to US Highway 190. The structure, located about 0.5 mile east of the Atchafalaya River, is reinforced concrete supported on untreated timber piles and contains two electrically-operated steel lift gates, each 10.5 feet wide and 15.0 feet high. This feature was completed in 1942 and modified in 1975. Operation and maintenance are the responsibility of the US Army Corps of Engineers.

- Pointe Coupee Pumping Station. Additional work originally planned for the Pointe Coupee area consisted of the enlargement of Bayou Latenache. As a result of drainage problems within the Pointe Coupee loop during the 1973 flood, studies were made that concluded a pumping station in lieu of enlarging Bayou Latenache outlet channel was economically justified.

A.4.74. Drainage Improvements West of Berwick. These improvements consist of a system of low level collection ditches, drainage structures, gated culverts, pumping plants, and ancillary work to provide interior drainage for the protected (inclosed) areas. Details of these improvements are shown in Table A-4-11. Deltaic activity has caused a progressive increase in gulfside stages for any given floodway discharge and therefore, in the stages for the design return frequency at each pumping plant discharge. As a result, there is now a shortfall in the capacity of each station for the design case; and since deltaic activity will continue, the shortfall will increase with time until deltaic stability is reached. Investigations are now underway to modify the pumping stations to restore the original design capacities for projected future floodside stages.

A.4.75. Lower Atchafalaya River. This feature is described under principal project features, paragraph A.4.24.

A.4.76. Wax Lake Outlet. This feature is described under principal project features, paragraph A.4.25.

IMPROVEMENTS FOR ACCESS, FISH AND WILDLIFE, AND RECREATION

A.4.77. Roads on Levees. Levee roads are provided to maintain an access road system. On the East Atchafalaya Basin Protection Levee

TABLE A-4-11

INTERIOR DRAINAGE WORKS WEST OF BERWICK, LOUISIANA

1. Bayou Yokely Area.

Feature	Pertinent Data	Status
Pumping plant	Enlarged to pump capacity of 580 cfs at a static head of 2.5', provided by 3 pumps of 193 cfs capacity.	Completed
Drainage structure	Four 72" diameter floodgates with capacity to discharge the design flood with sump pool stages limited to 3.5' Automatic flap and normal slide type gates.	Completed 9 Apr 1963
Gated culverts	2-gated culverts into Bayou Yokely	In place
Low level drainage ditches	Approximately 3.6 miles in length along the western and southern boundaries of the Bayou Yokely Area	Completed

2. Franklin Area.

Feature	Pertinent Data	Status
Pumping plant	Enlarged to total pump capacity by 260 cfs by addition of a pumping station with 2 pumps of 58 cfs capacity. Existing station has 2 pumps of 72 cfs capacity.	Completed
Gated culverts	Three 60" CMP culverts with automatic flap gates.	In place
Low level drainage ditches	Approximately 4.2 miles in length along the western and southern boundaries of the Franklin area.	Completed

3. Centerville Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 330 cfs at a static head of 2.5' is provided by 3 pumps of 110 cfs capacity each.	Completed 25 May 64
Gated culverts	Three 60" CMP culverts through the levee at the pumping station.	In place
Gated culvert	One 60" CMP culvert with flapgate.	In place
Low level drainage ditches	Approximately 4.8 miles in length generally along the southern boundary.	In place

4. Maryland Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 134 cfs at a static head of 2.5' is provided by 2 pumps at 67 cfs capacity.	Completed 31 May 1957
Gated culverts	Three 60" CMP culverts with flapgates.	In place
Gated culvert	One 36" CMP culvert with flapgate.	In place
Low level drainage ditches	Approximately 3.6 miles in length along the northern & western boundaries of the Maryland area.	Completed

5. North Bend Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 50 cfs at a static head of 3' is provided by 2 pumps of 25 cfs capacity.	Completed 15 Nov 1962
Gated culvert	One 60" CMP culvert with floodgate.	In place
Gated culverts	Two 36" CMP culverts with floodgate.	In place
Low level drainage ditches	Approximately 1.9 miles in length along the western boundary of the North Bend Area.	Completed

TABLE A-4-11 (Continued)

INTERIOR DRAINAGE WORKS WEST OF BERWICK, LOUISIANA

6. Ellerslie Area.

Feature	Pertinent Data	Status
Pumping plant	A pumping capacity of 140 cfs at a static head of 3' by 2 pumps of 70 cfs capacity.	Completed 8 Apr 1953
Gated culverts	Two 60" CMP culverts with floodgates.	In place
Gated culverts	One 60" CMP and one 72" GIP with floodgates.	In place
Low level drainage ditches	Approximately 6.2 miles in length generally along all boundaries except the NE portion of the Ellerslie area.	Completed

7. Gordy Area.

Feature	Pertinent Data	Status
Pumping plant	Pump capacity of 230 cfs at a static head of 2.5' is provided by one 50 cfs and two 90 cfs pumps.	Completed 10 Feb 1964
Gated culverts	Two 60" CMP culverts with automatic flapgates; gravity drained	In place
Low level drainage ditches	Approximately 8.5 miles in length generally along all boundaries except the NE portion of the Gordy area.	Completed

8. Wax Lake West Area.

Feature	Pertinent Data	Status
Pumping plant	Pump capacity of 500 cfs at a static head of 4' provided by 3 pumps of 167 cfs capacity.	Completed 13 Apr 1965
Drainage structures	Contains 15 automatic flap gates having a total cross sectional area of 285 sq. ft. and a capacity of 3"/ day under a 1' head differential; gravity drained.	Completed 16 Jun 1954
Low level drainage ditches	Approximately 3.4 miles in length along a portion of the southern boundary.	Completed

9. Wax Lake East Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 1,000 cfs at a static head of 6' is provided by 4 pumps of 250 cfs capacity.	Completed 7 Dec 61
Drainage structure	Consists of a gated floodwall type control structure with 25 combination automatic flap gate & manually controlled slide gates, each 5' in diameter.	Completed 18 Dec 1954
Gated culverts	Three gated culverts	In place
Gated culverts	Two gated culverts.	Authorized; const. not begun
Inverted siphon	Maximum discharge of 1,150 cfs Structure consists of siphon approach & ext. channels, siphon intake section, trash rack, barrel, outlet section, and connecting channel & culvert inlet outlet & barrel.	Completed 27 Aug 63
Low level drainage ditches	Approximately 24.4 miles in length generally along the entire boundary except for a small portion (approx. 4 mi)	Completed
Channel closures	Two closures consisting of embankment placed by hydraulic dredge.	Completed

and West Atchafalaya Basin Protection Levee, final location of the roadway will, for the most part, be on the landside berm. This roadway, will have a 20-foot crown graded a minimum of one-foot above the 25-year design flood on the landside. After roadways have been constructed, gravel surfacing will be applied. Table A-4-12 shows the location and length of the roads.

A.4.78. Public Use Areas. A program has been proposed to develop 29 recreation areas, including parking and boat-launching facilities. Table A-4-13 contains basic information on the sites. (This is not the public use plan that is being considered in this study.)

A.4.79. East and West Access Channels. This feature consists of channels, minus 7 feet by 80 feet, which provide navigable connections between the east and west Atchafalaya guide levees. An additional function of these channels is to distribute freshwater to the overbank areas they traverse. Maintenance dredging of the channels averages about 750,000 cubic yards per year. The disposal is confined to the banks adjacent to the waterways.

A.4.80. East and West Freshwater Distribution Channels. These are maintained to distribute freshwater to the east and west sides of the Lower Atchafalaya Basin Floodway during seasons of low water. Maintenance consists of removal of obstructions such as debris, sediments, and other major obstacles to flow.

A.4.81. East and West Freshwater Diversion Structures. Each structure will consist of two 10-foot by 10-foot gated reinforced concrete culverts. Water introduced by gravity flow into the Ramah area of the Lower Atchafalaya Basin Floodway, east of the Atchafalaya River, will be distributed by the structure at Sherburne through Big Alabama Bayou, Bayou des Glaises, and connecting channels. Water introduced into the Henderson Lake area of the Lower Atchafalaya Basin Floodway, west of the Atchafalaya River, will be distributed by the Bayou Courtableau freshwater diversion structure through Little Fordoche Bayou and connecting swamp channels.

A.4.82. Dredge Material Retaining Dikes. A system of retention dikes has been provided to prevent damage to high value fish and wildlife habitat in the Lower Atchafalaya Basin Floodway. These disposal retention dikes serve to confine dredged material.

FLOWAGE EASEMENTS

A.4.83. Below Krotz Springs. The Flood Control Act of 15 May 1928, as amended by the Flood Control Act of 28 June 1938, authorized the Chief of Engineers to purchase flowage easements over all lands below

TABLE A-4-12

ROADS ON LEVEES

Description	Length In Miles
Roads, gravel or shell-surfaced:	
Morganza upper guide levee	8.9
Morganza lower guide levee	19.5
East Atchafalaya Basin Protection levee	85.5
West Atchafalaya Basin Protection levee	127.7
East Atchafalaya River levee	52.5
West Atchafalaya River levee	60.1
Simmesport ring levee	1.6
Melville ring levee	4.1
Krotz Springs ring levee	1.7
Bayou des Glaises fuseplug levee	7.9
Mansura Hills to Hamburg levee	20.5
Levees west of Berwick	56.5
TOTAL	446.5

TABLE A-4-13

PUBLIC USE AREAS

Site No.	Location	Proposed Improvements			
		Concrete Ramp	Launching Area (ft^2)	Parking Area (ft^2)	Other
1	Ramah	-----	18,000	40,000	Levee ramp
2	Bayou Maringouin	3 lanes	18,000	60,000	Levee ramp
3	Upper Grand River	5 lanes	18,000	100,000	Levee ramp
4	Bayou Sorrel	5 lanes	18,000	400,000	Levee ramp
5	Big Bayou Pigeon	5 lanes	18,000	100,000	Levee ramp
6	Bayou Postillion	3 lanes	18,000	60,000	Levee ramp
7	Old River	5 lanes	18,000	100,000	Levee ramp
8	Belle River	5 lanes	18,000	100,000	Levee ramp
9	Little Bayou Sorrel	3 lanes	18,000	60,000	Levee ramp
10	Flat Lake	5 lanes	18,000	100,000	Levee ramp
11	Bayou Boeuf	2 lanes	------	26,400	Access road (0.2 mile)
12	Bayou Courableau	6 lanes	------	90,000	Access road (0.5 mile)
13 [1]	Henderson Lake	15 lanes	36,000	300,000	Levee ramps(3)
14	Catahoula	2 lanes	12,000	40,000	Levee ramp
15	Bayou Benoit	------	------	50,000	Misc. fac.
16	Grand Bayou	5 lanes	18,000	400,000	Levee ramp
17	Little Lake Long	3 lanes	18,000	60,000	Levee ramp
18	Lake Fausse Pointe	2 lanes	18,000	40,000	Misc. fac.
19 [1]	Charenton Beach	5 lanes	18,000	200,000	0.4 mile of roads, levee ramp, fill, etc.
20	Myette Point	-----	-----	50,000	Misc. fac.
21	Verdunville Landing	5 lanes	18,000	100,000	Levee ramp
22	Wax Lake Outlet	2 lanes	-----	40,000	Levee ramp
23	Lower Atchafalaya Closure	5 lanes	18,000	100,000	Levee ramp
24	GIWW Landing	5 lanes	18,000	100,000	Levee ramp
25	Swayze Lake	2 lanes	------	25,000	Access road (0.1 mile)
26	Sherburne structure	2 lanes	18,000	48,000	Misc. fac.
27 [1]	Bayou des Glaises, Pat's Throat & Little Tensas Bayou	2 lanes (3)	------	33,000 (3)	Access road (19.0 miles)
28	Courtableau Structure	2 lanes	12,000	48,000	Misc. fac.
29	Opelousas Bay	3 lanes	18,000	60,000	Access road (0.6 mile)
	TOTALS	85 lanes	348,000	2,397,000	
		[2] 111 lanes	402,000	3,997,000	

[1] Approval deferred-Letter ENGCW (NOD 25 May 67); Subject: Public Access and Recreational Development.

[2] Totals including deferred sites.

the latitude of Krotz Springs that were not considered subject to frequent overflow as of 1928. As determined by the Chief of Engineers at that time, only those lands on which the title was clear (and the owner had presented a claim and was agreeable to the appraised value) were subject to the payment of flowage easements. Condemnation was not authorized. Due to the costliness of this process, acquisition of easements in this category is on a case-by-case basis.

A.4.84. West Atchafalaya Floodway. Perpetual flowage easements on approximately 154,347 acres were acquired by the Government over all lands and improvements in the floodway down to the latitude of Krotz Springs. These easements provide for full use of the lands for flood control purposes. Owners retain the rights to farm, improve, build houses and inhabit the lands, and to harvest timber and minerals.

A.4.85. Morganza Floodway. Comprehensive easements on approximately 71,577 acres of land within the floodway have been acquired for the passage of floodwaters into the Lower Atchafalaya Basin Floodway. Construction for permanent habitation within the floodway is not permitted, but use of the land for farming, removal of timber and minerals, and other purposes not in conflict with flood control is permitted with prior approval.

A.4.86. Upper Pointe Coupee Area. Inundation rights have been acquired on 12,801 acres of land above the Pointe Coupee drainage structure for storage of runoff when it becomes necessary to close the gates in the upper guide levee during operation of the Morganza Floodway.

A.4.87. Morgan City Front. Flowage easement has been acquired on 18 acres in connection with the Morgan City front levee.

A.4.88. Bayou des Glaises Loop. Flowage easements have been acquired on approximately 16,091 acres within the Bayou des Glaises loop.

A.4.89. Bayou Chene. Flowage easements have been acquired on 692 acres.

RELOCATIONS AND ALTERATIONS

A.4.90. Details on the relocations and alterations accomplished are shown in Table A-4-14.

A.4.91. US 190 High Level Crossing. This crossing, between Lottie and Courtableau, consists of approximately 12 miles of an elevated four-lane twin-bridge highway, averaging about 29 feet above natural ground level. This crossing is made of a combination of earth embankment and reinforced concrete bridge supported by piling. During

TABLE A-4-14

RELOCATIONS AND ALTERATIONS

No.	Feature	Type	Dimensions			Status
			Length	Height	Clear Width	
63	US 190 High Level Crossing	New const.	Approx.	29. feet avg.	56 feet	Completed
64	The New Orleans, Texas, and Mexico Railway High Level Crossing	New const.	12 miles		11 feet	Completed Sep 1961
65	Opelousas–Ville Platte–Bunkie RR Connection	New const. Alterations	16 miles 20 miles			Completed Feb 1950
66	Texas & Pacific RR Crossing at Melville	Alteration	687 feet addition	50.2 feet	-	Completed Nov 1952
67	Gulf States Utilities Powerline Crossing	New const.	3,500 feet ±	Power Line (varies) 270 feet ± (structures)		Completed
68	Raising Berwick Bay Bridges (So. Pacific Railway & US Hwy. 90 Bridges)	Alteration				Completed
69	LA Hwy. 129 (LA Hwy 87) Bridge (Charenton Canal)	New const.				Completed Nov 1940
70	US 90 Bridge (Charenton Canal)	New const.				Completed Jun 1940
71	Texas & New Orleans RR Bridge (Charenton Canal)	New const.				Completed Dec 1941
72	Louisiana & Ark RR Bridge (Simmesport)	Alteration	897 feet addition	--	--	Completed Dec 1938
73	New Orleans, Texas, & Mexico RR Bridge (Krotz Springs)	Alteration	1,270 feet addition	--	--	Completed 1941
74	US 90 Bridge (Wax Lake Outlet)	New const.				Completed Nov 1942
75	Southern Pacific RR Bridge (Wax Lake Outlet)	New const.				Completed Nov 1942
76	LA Hwy. 1 (Morganza)	New const.		63.76 feet	30 feet ±	Completed Feb 1960
77	Texas & Pacific RR Bridge (Morganza)	New const.		64.25 feet	15 feet ±	Completed Feb 1960
78	Numerous oil & gas pipelines, powerlines, etc.	New const. & alterations				
79	Texas & Pacific High Level RR Crossing McKneeley to Palmetto and adjustment of tracks and facilities	Alterations				Completed Nov 1967

operation of the floodway, this crossing will provide a usable east-west highway route.

A.4.92. The New Orleans, Texas, and Mexico Railway High-Level Crossing. This crossing, between Lottie and Courtableau, provides means by which uninterrupted traffic can be maintained by the New Orleans, Texas, and Mexico Railroad; the Texas and Pacific Railway, the Missouri Pacific Railroad, and the Kansas City Southern Railway during floods when operation of the West Atchafalaya Floodway is required. The single-track, high-level crossing, approximately 12 miles long, is composed of earth embankment and reinforced concrete ballaster deck-type trestle supported on piling.

A.4.93. Opelousas-Ville Platte-Bunkie Railway Connection. The Opelousas-Ville Platte-Bunkie Railway connection, located west of the West Atchafalaya Floodway between Opelousas and Bunkie, was constructed in lieu of two additional high-level crossings over the West Atchafalaya Floodway for the Texas and Pacific and the Kansas City Southern Railways. The connection included construction of 16 miles of new single-track railroad between Opelousas and Ville Platte and the rehabilitation and strengthening of about 20 miles of single-track railroad between Ville Platte and Bunkie.

A.4.94. Texas and Pacific Railroad Crossing at Melville. This crossing consists of a 687-foot addition to the existing railroad crossing.

A.4.95. Gulf States Utilities Powerline Crossing. This powerline is elevated over the Whiskey Bay Pilot Channel.

A.4.96. Raising Berwick Bay Bridges. To accommodate navigation during diversion of floodwaters through the Atchafalaya Basin, the railway (Southern Pacific) and highway (US 90) bridges across Berwick Bay were raised.

A.4.97. LA Hwy 129 (LA 87) Bridge (Charenton Canal). This bridge provides access across the Charenton drainage canal.

A.4.98. US 90 Bridge (Charenton Canal). This bridge also provides access across the Charenton drainage canal.

A.4.99. Texas and New Orleans Railroad Bridge (Charenton Canal). The Texas and New Orleans Railroad bridge provides access across the Charenton drainage canal.

A.4.100. Louisiana and Arkansas Railroad Bridge (Simmesport). This feature consists of lengthening the existing railroad bridge in conjunction with channel improvement dredging.

A.4.101. New Orleans, Texas and Mexico Railroad Bridge (Krotz Springs). This consists of lengthening the existing highway and railroad bridge in conjunction with channel improvement dredging.

A.4.102. US 90 Bridge (Wax Lake Outlet). This feature provided for construction of a new bridge for US Highway 90 over the dredged channel.

A.4.103. Southern Pacific Railroad Bridge (Wax Lake Outlet). This new bridge was constructed to carry the Southern Pacific line over the dredged channel.

A.4.104. LA Highway 1 (Morganza). This highway is supported on 3-foot-wide piers of the Morganza control structure. The earth embankment on each side of the control structure also serves to carry the highway across the floodway.

A.4.105. Texas Pacific Railroad Bridge (Morganza). This bridge is supported on 3-foot-wide piers of the control structure. The earth embankment on each side of the control structure also serves to carry the railroad bridge across the floodway.

A.4.106. Texas and Pacific Railroad, Readjustment of Line Between McKneely and Palmetto. This feature provides for high level crossing by adjustment of track and facilities.

A.4.107. Numerous Oil and Gas Pipelines, Powerlines, etc.

MAINTENANCE DREDGING

A.4.108. Maintenance dredging within the Atchafalaya Basin consists of dredging approximately 2,450,000 cubic yards per year. Dredging frequency, average yardage per dredging event, and disposal areas are shown in Table A-4-15.

MODIFICATIONS TO STRUCTURES

A.4.109. In addition to the necessary raising of levees and floodwalls due to increases in flowlines, some navigation and drainage structures associated with the project will also require modifications. These structures include the Bayou Sorrel, Bayou Boeuf, and Berwick locks; the Charenton and Calument floodgates; and drainage structures and pumping stations on the levees west of Berwick.

TABLE A-4-15

MAINTENANCE DREDGING

Location	Dredging Frequency	Average Cubic Yards per Dredging Event	Disposal Areas
Below Bayou Sorrel (GIWW Port Allen-Morgan City Route)	Annually	250,000	Confined on bank adjacent to waterway
Sixmile Lake	Once every 5 years	480,000	Disposed on bank adjacent to channel and in deep water of channel.
Berwick Bay Harbor	Annually	500,000	Disposed in deep water in Atchafalaya River
East Freshwater Distribution Channel	Once every 10 years	160,000	Confined on bank adjacent to waterway
E&W Access Channels	Once every 10 years	610,000	Confined on bank adjacent to waterway
Old River Lock Tailbay	Once every 10 years	7,000	Confined on bank adjacent to waterway
Berwick Lock Forebay	Once every 2 years	70,000	Disposed in deep water in Atchafalaya River and in shallow water adjacent to forebay
Three Rivers (mile 0)	Annually	150,000	In deep water of the Atchafalaya River
Below Bayou Sorrel (Alternate Route GIWW)	Annually	170,000	Confined on banks adjacent to waterway

OPERATION AND MAINTENANCE

A.4.110. The Federal Government is responsible for all operation and maintenance of the authorized project, except for those required of local interests, the State of Louisiana and the owners of utilities and transportation features relocated because of the project.

A.4.111. Local Interests. The responsibilities of local interests include routine maintenance of levees and floodwalls, including mowing and surveillance of levee conditions; operation, routine maintenance and minor repair of pumping stations; and operation and maintenance of all gravity drainage improvements associated with the East and West Atchafalaya Basin Protection Levees. Exceptions, which remain the responsibility of the Federal Government, are major repairs to pumping stations and the operation and maintenance of the drainage features listed below. Responsibility of the Federal Government for major repairs to the new Franklin pumping station and the Yokely pumping station are limited to a maximum of 55 percent and 45 percent of total costs, respectively. Drainage features are Bayou Darbonne drainage structure and channels, Bayou Courtableau drainage structure and channels, Bayou Courtableau diversion structures and channels, Charenton floodgate and drainage canal, and Bayou Boeuf-Bayou Long-Bayou Chene drainage canal.

A.4.112. State of Louisiana. The State of Louisiana, Department of Highways, is responsible for operating and maintaining all highway and highway bridge relocations and is also responsible for sharing in the operation and maintenance cost of the vertical lift bridge at Old River lock.

A.4.113. Others. The owners of other relocations (railroads, pipelines, powerlines, etc.) are responsible for their operation and maintenance.

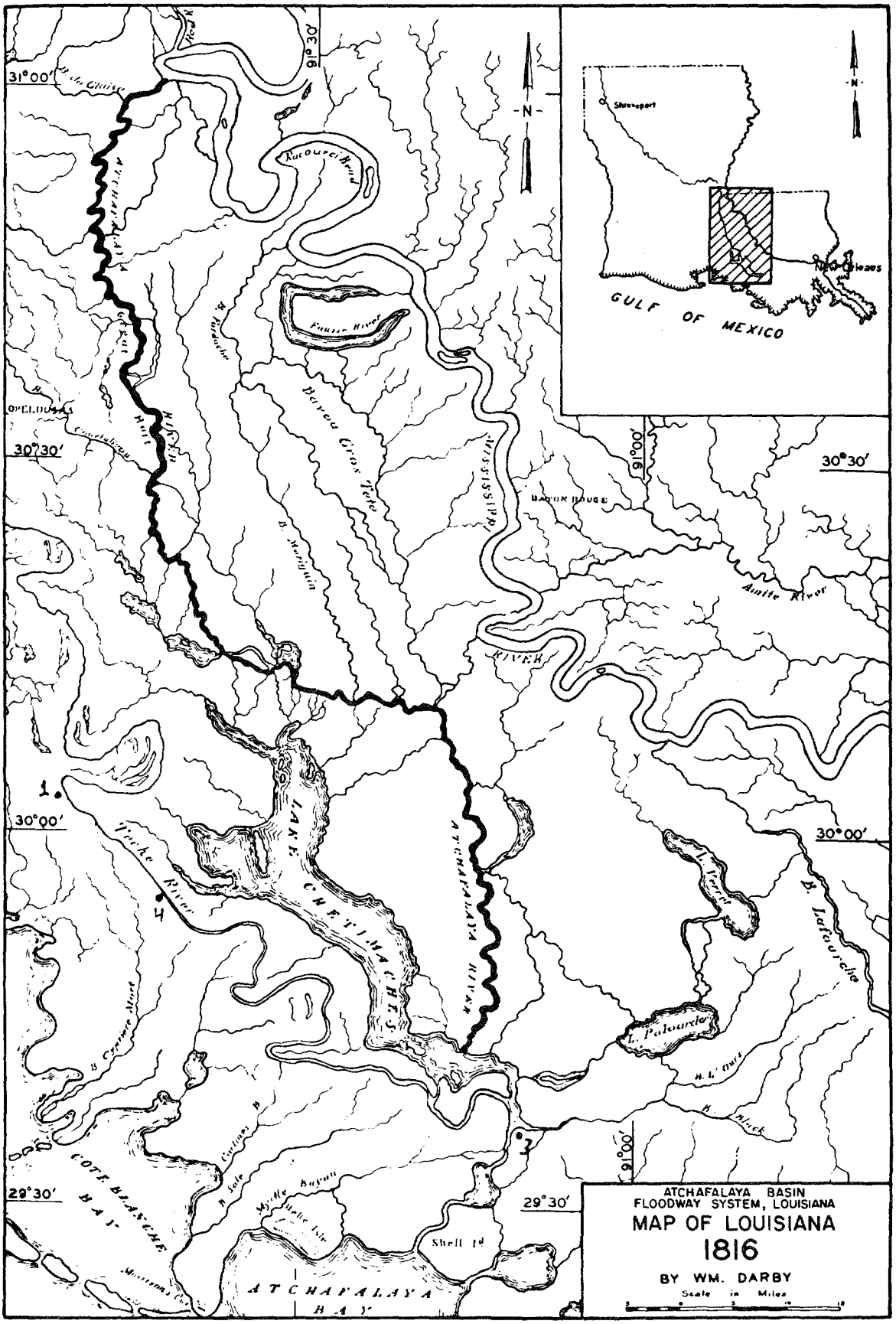
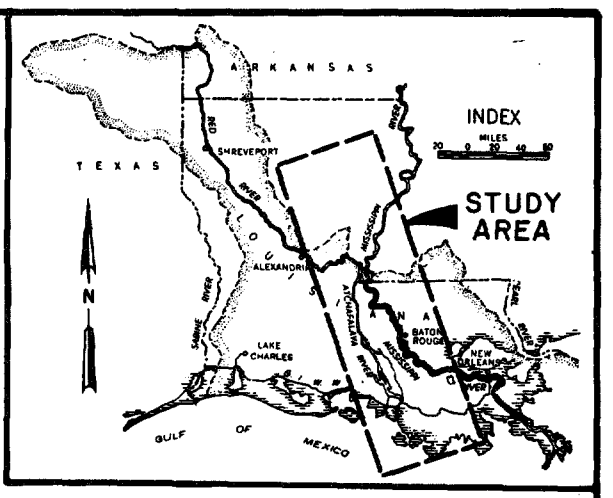

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAP OF LOUISIANA
1816
BY WM. DARBY
Scale in Miles
GULF OF MEXICO
Shreveport
New Orleans
31°00'
30°30'
30°00'
29°30'
91°30'
91°00'
Racourci Road
Fausse River
Bayou Gros Tete
MISSISSIPPI
RIVER
BATON ROUGE
Amite River
OPELOUSAS
Torche River
LAKE CRETIMACHES
ATCHAFALAYA RIVER
L. Verret
B. Lafourche
L. Palourde
COTE BLANCHE BAY
ATCHAFALAYA BAY
Shell Id
Myrtle Bayou
Belle Isle
1
3
4

PLATE A-1



MANSURA HILLS
Bayou des Glaises
Outflow Channel
Old River Control Structures
Hamburg
RED RIVER
Bunkie
Simmesport
Bayou des Glaises Diversion Channel
MISSISSIPPI
LOUISIANA
Angola
Old River Lock
WEST ATCHAFALAYA FLOODWAY
Pointe Coupee Loop
Morganza Control Structure
MISSISSIPPI RIVER
Ville Platte
Melville
MORGANZA FLOODWAY
Morganza
Opelousas
Krotz Springs
Lottie
HWY 190
Port Allen
Old Atchafalaya River
Henderson Lake
Henderson
Butte La Rose
Plaquemine
Lafayette
Catahoula
Saint Martinville
LAKE DAUTERIVE
Bayou Sorrel Lock
Donaldsonville
New Iberia
Atchafalaya River Main Channel
Pierre Part
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
Charenton
LAC DES ALLEMANDS
Backwater Area
VERMILLION BAY
Franklin
Thibodaux
WEST COTE BLANCHE BAY
Patterson
Berwick
Morgan City
Amelia
EAST COTE BLANCHE BAY
Bayou Boeuf Lock
Houma
MARSH ISLAND
Avoca Island Levee
Avoca Island - Cutoff
ATCHAFALAYA BAY
ATCHAFALAYA DELTA WILDLIFE MANAGEMENT AREA
HNC
Chene, Boeuf, and Black Navigation Channel
Pointe au Fer Reef
Terrebonne Parish Marshes
Four League Bay
GULF OF MEXICO
-20 Contour
SCALE OF MILES
5 0 5

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

GENERAL MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-2

MISSISSIPPI
LOUISIANA

Simmesport
Melville
Port Barre
OPELOUSAS
Krotz Springs
NORTHERN LIMITS OF PRE HISTORIC GRAND LAKE
Arnaudville
Breaux Bridge
Lafayette
St Martinsville
LOWLAND
Loreauville
NORTHERN LIMITS OF GRAND LAKE 1934
New Iberia
Jeanerette
Charenton
WATERWAY
INTRACOASTAL
Baldwin
Franklin
SECTION
Patterson
Morgan City
MARSH ISLAND
ATCHAFALAYA BAY
Point Au Fer Shell Reef
POINT AU FER ISLAND
FOUR LEAGUE BAY
LAKE PALOURDE
LAKE VERRET
GRAND LAKE
SIX MILE LAKE
UPPER GRAND RIVER
LOWER GRAND RIVER
MISSISSIPPI RIVER
Port Allen
BATON ROUGE
U S HWY 190
Plaquemine
Donaldsonville
Thibodaux
LOWLAND

-N-

LEGEND
- LIMITS OF ATCHAFALAYA BASIN
- TECHE-MISSISSIPPI MEANDER BELT
- LAFOURCHE-MISSISSIPPI MEANDER BELT
- MODERN MISSISSIPPI MEANDER BELT
- MODERN LAFOURCHE-MISSISSIPPI MEANDER BELT

SCALE

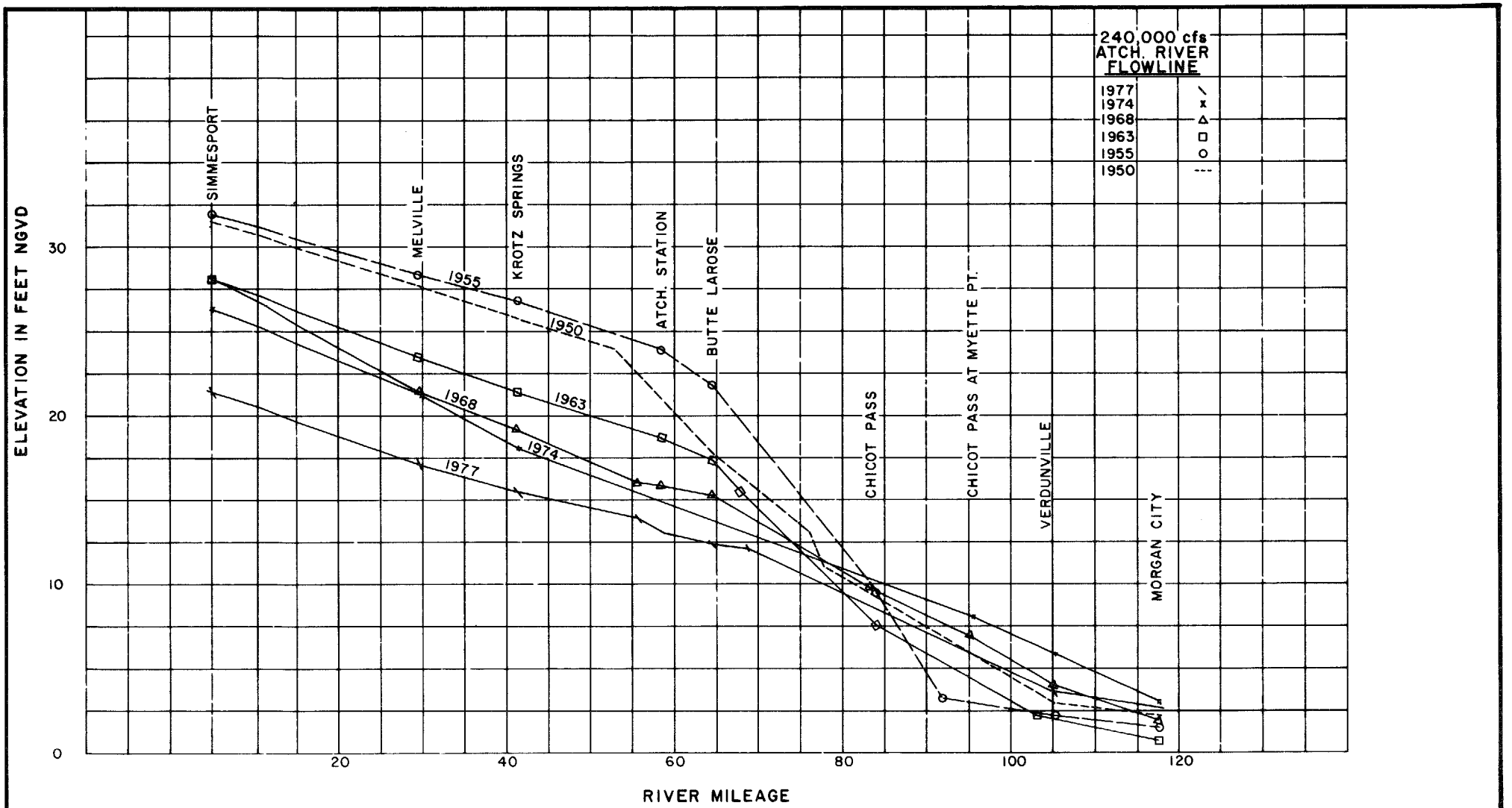
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

PHYSIOGRAPHY OF THE ATCHAFALAYA BASIN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE A-3

PLATE A-3



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

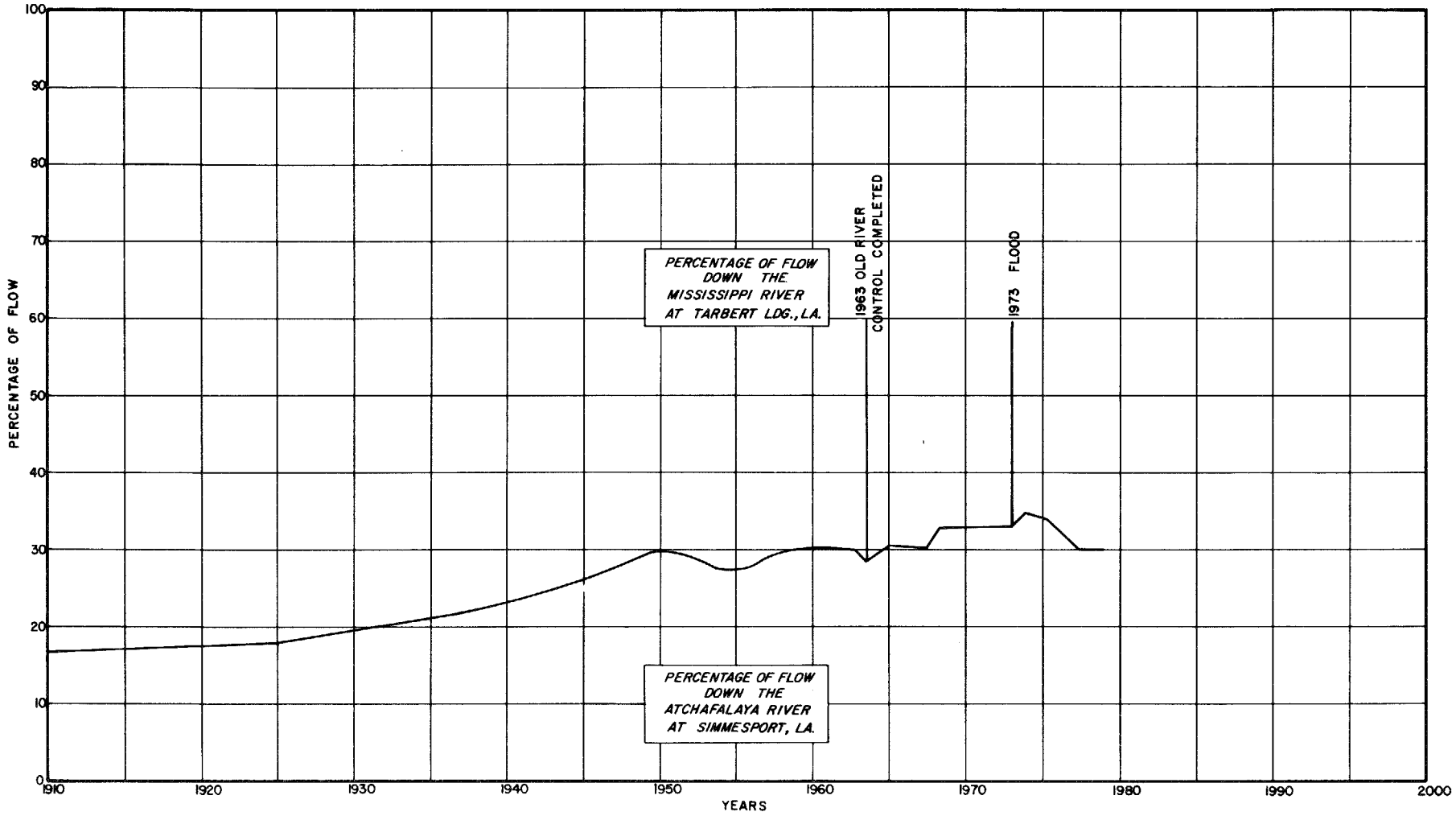
ATCHAFALAYA RIVER STAGES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE A-4



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

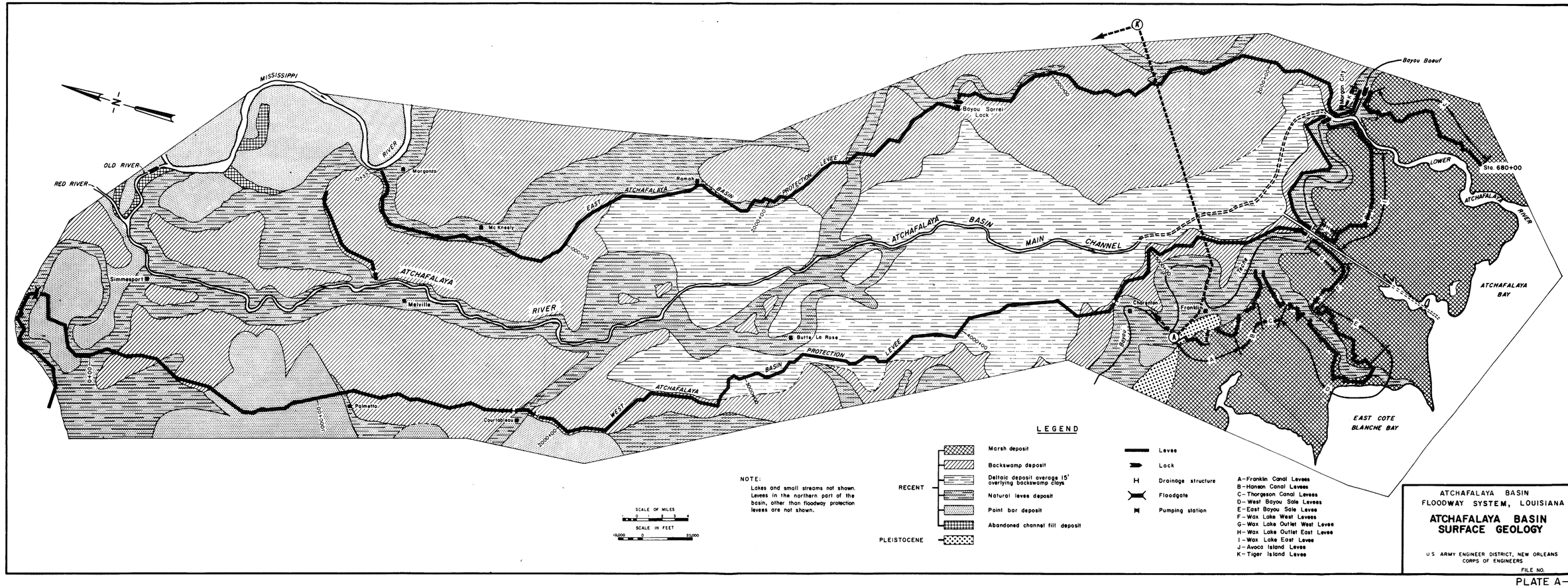
TOTAL FLOW AT LATITUDE OF OLD RIVER

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE A-5

PLATE A-5



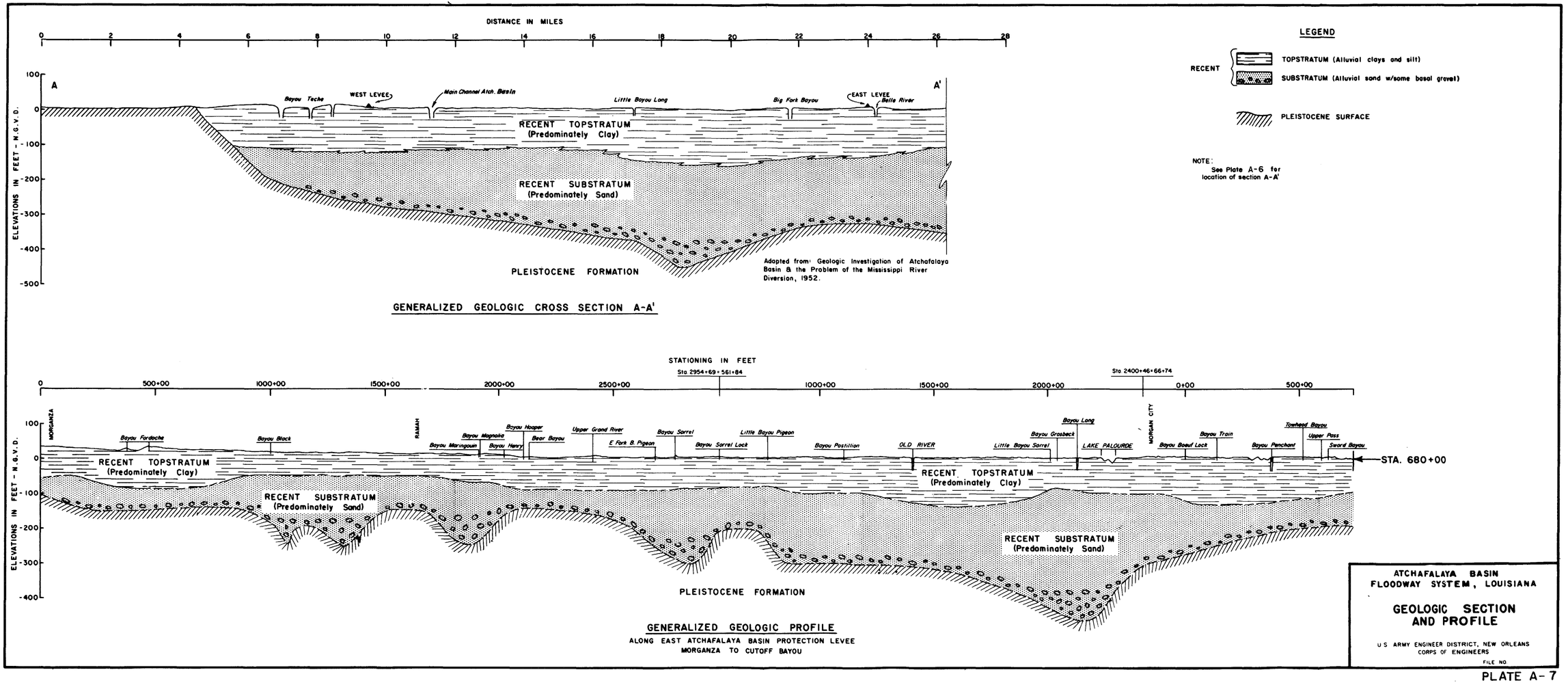
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN SURFACE GEOLOGY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-6



GENERALIZED GEOLOGIC CROSS SECTION A-A'

GENERALIZED GEOLOGIC PROFILE
ALONG EAST ATCHAFALAYA BASIN PROTECTION LEVEE
MORGANZA TO CUTOFF BAYOU

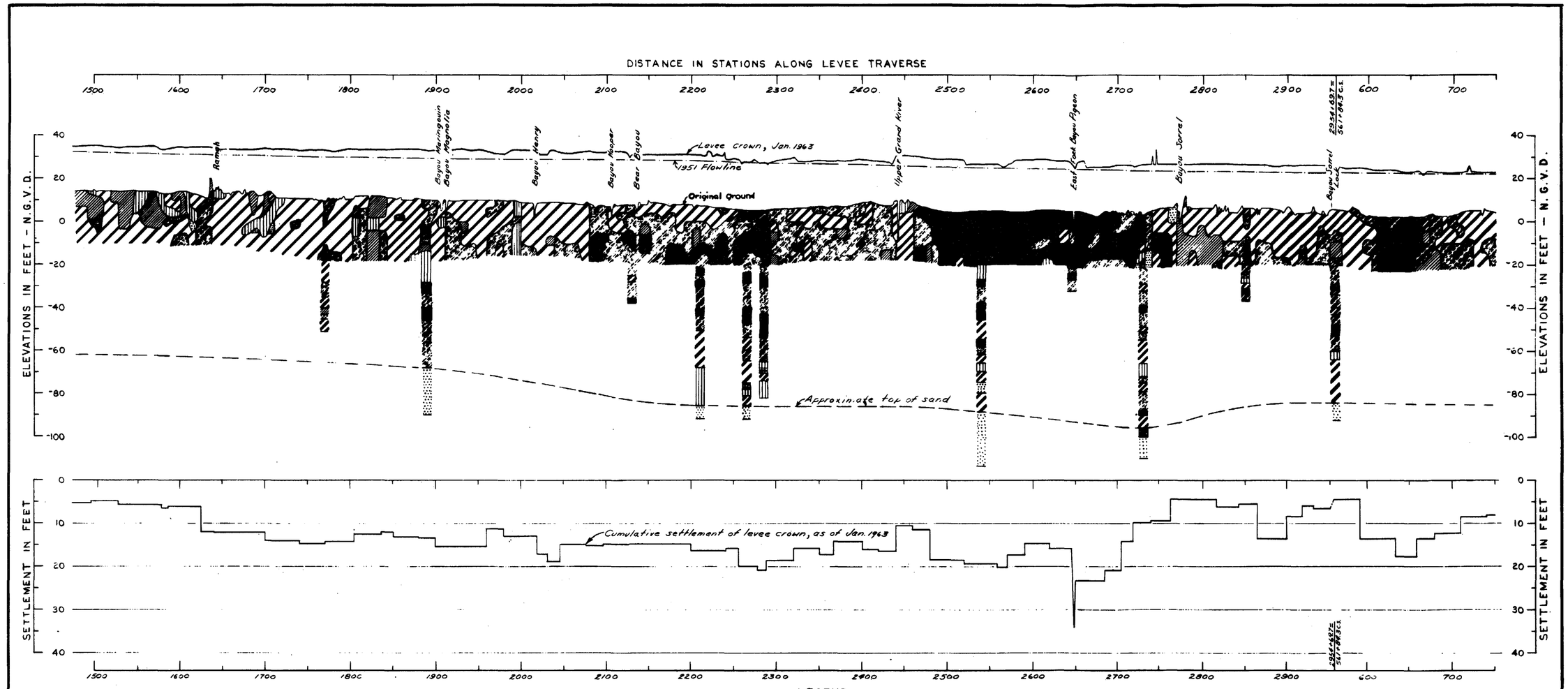
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

GEOLOGIC SECTION
AND PROFILE

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-7



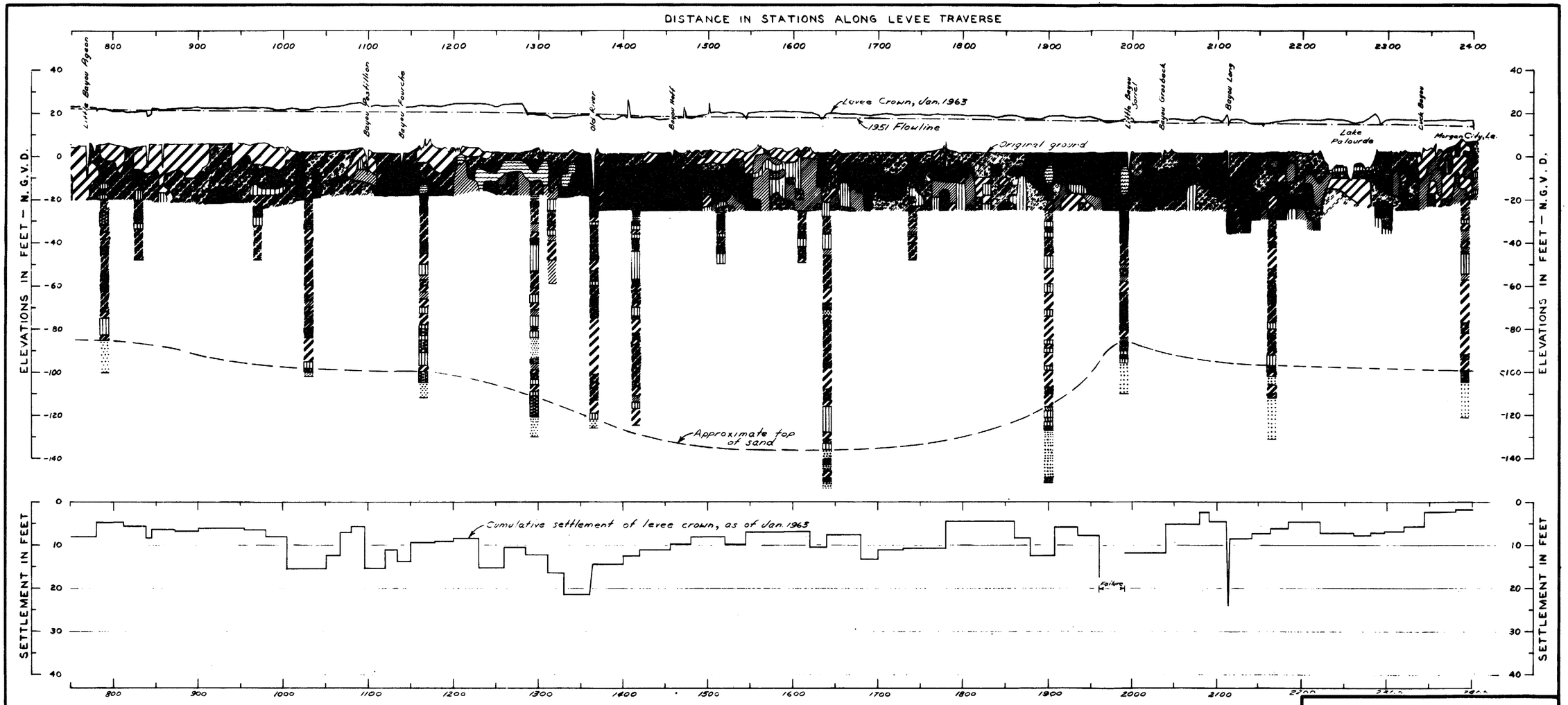
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND SETTLEMENT DATA

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO

PLATE A-8



NOTE: FOR LEGEND SEE PLATE A-8

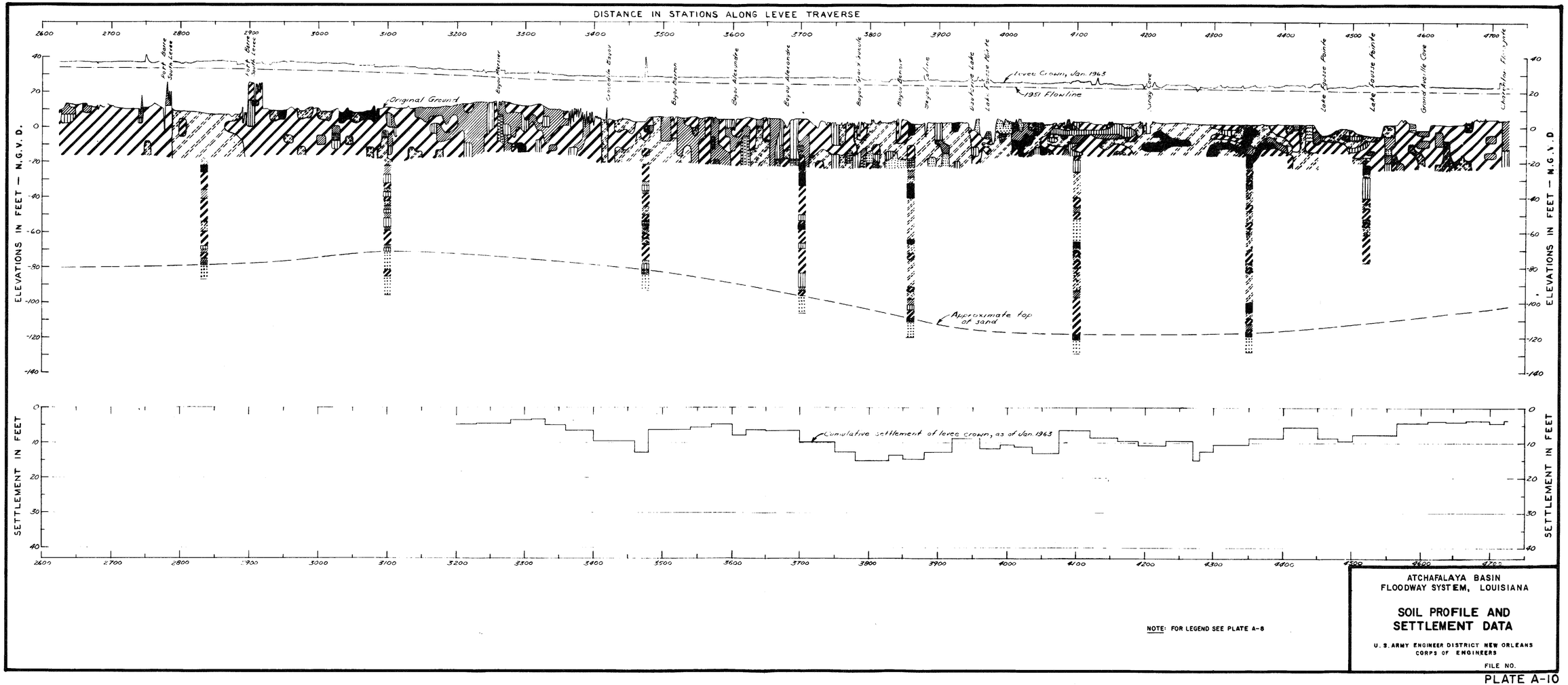
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND SETTLEMENT DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-9



NOTE: FOR LEGEND SEE PLATE A-8

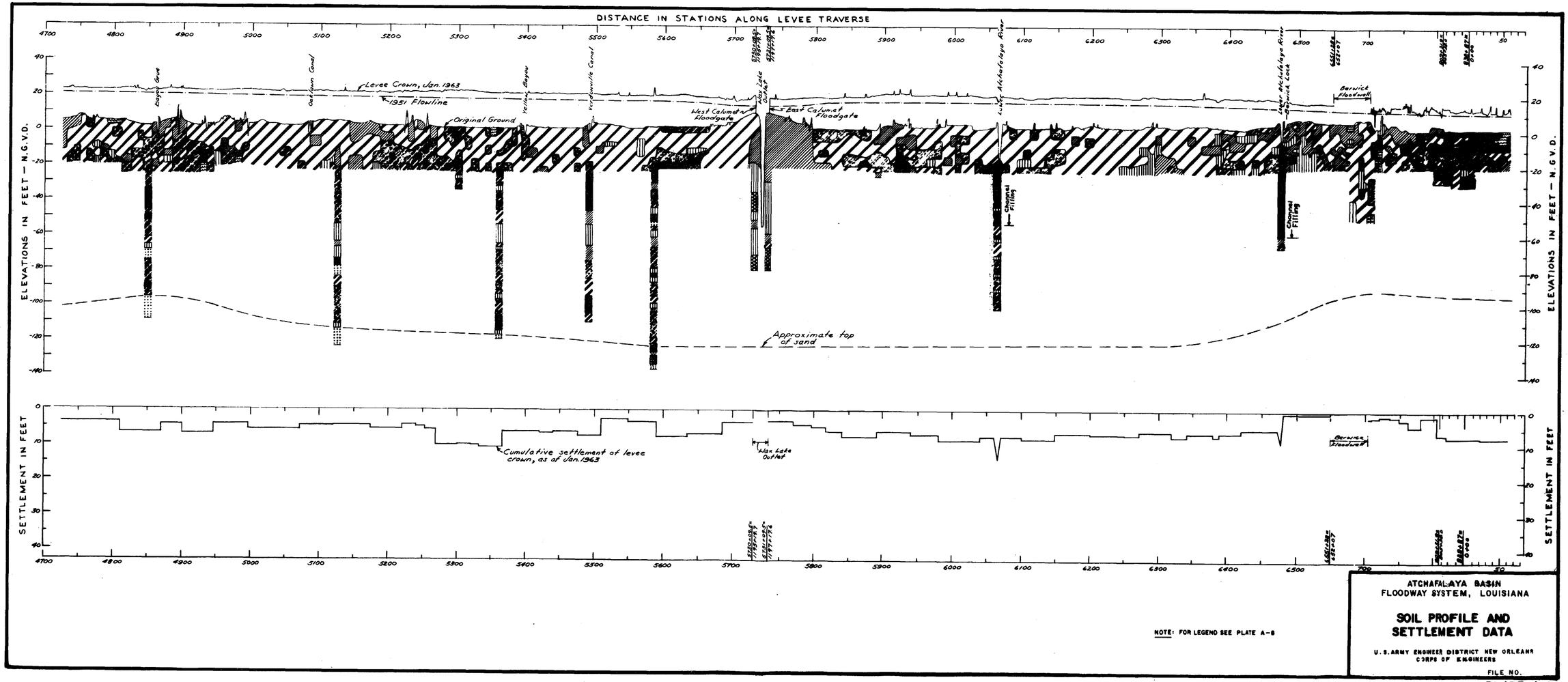
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND SETTLEMENT DATA

U. S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-10



NOTE: FOR LEGEND SEE PLATE A-8

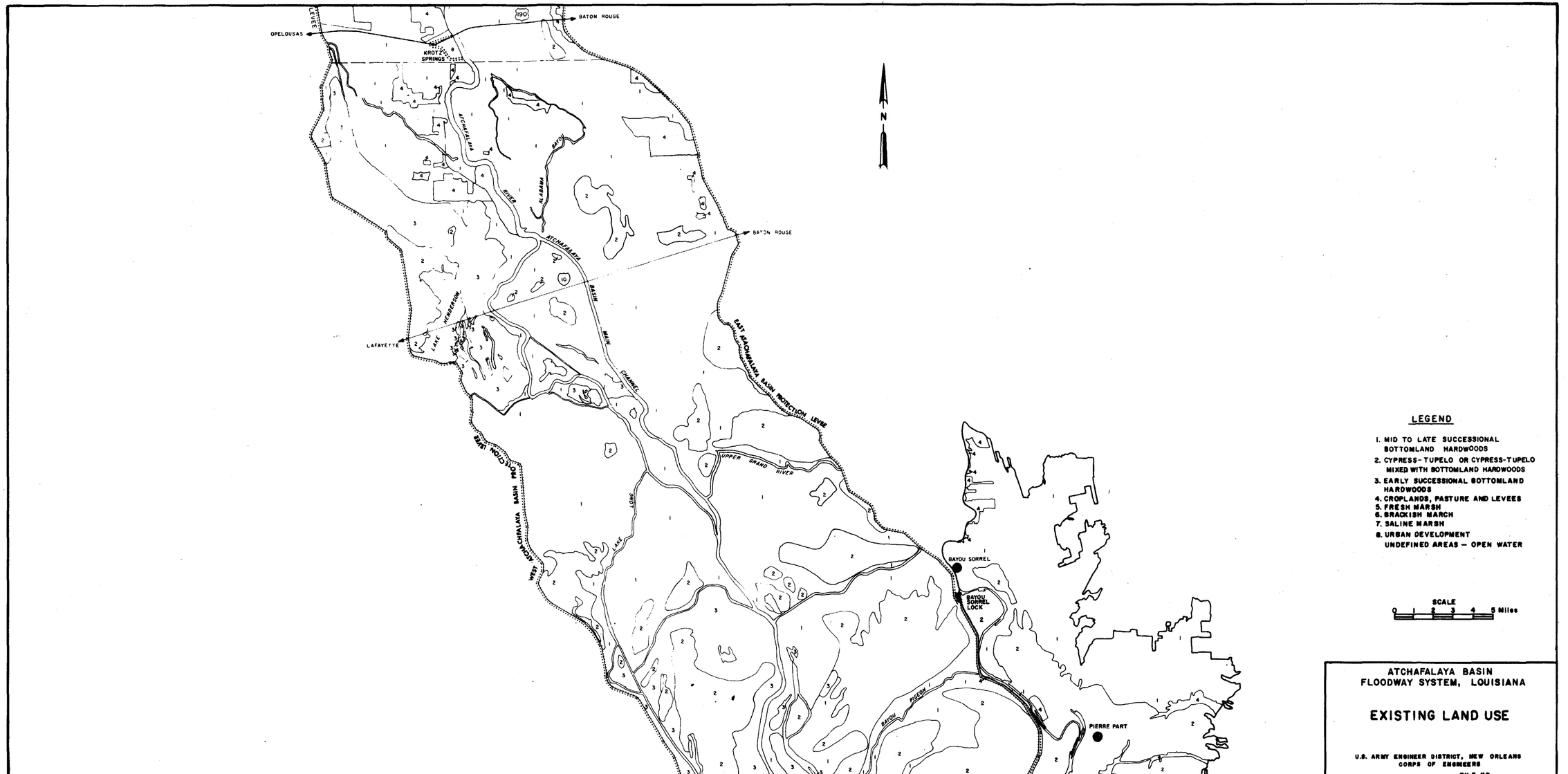
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND SETTLEMENT DATA

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-11



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

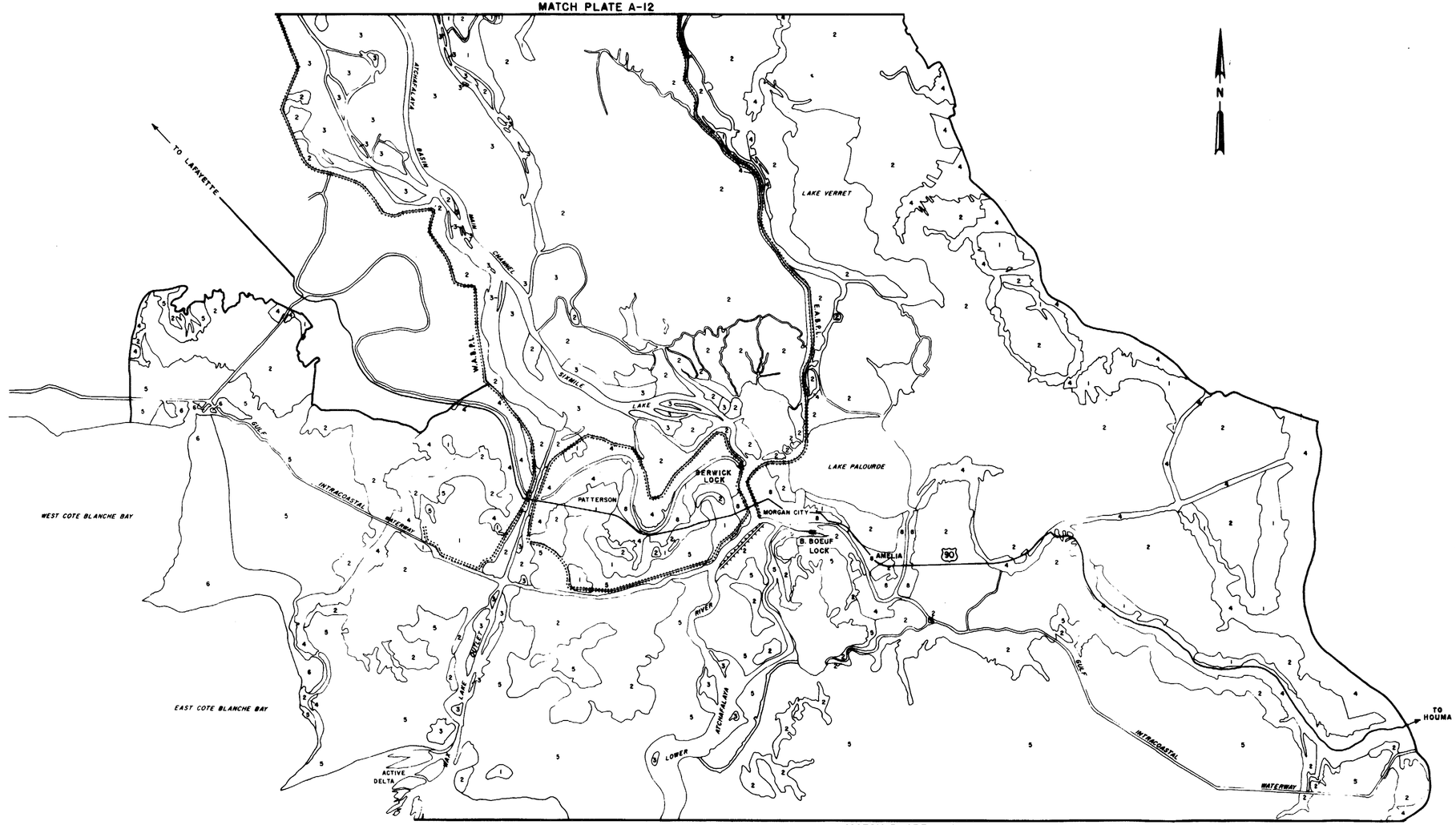
EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

MATCH PLATE A-13

PLATE A-12

MATCH PLATE A-12



MATCH PLATE A-14

LEGEND

1. MID TO LATE SUCCESSIONAL BOTTOMLAND HARDWOODS
2. CYPRESS-TUPELO OR CYPRESS-TUPELO MIXED WITH BOTTOMLAND HARDWOODS
3. EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS
4. CROPLANDS, PASTURE AND LEVEES
5. FRESH MARSH
6. BRACKISH MARSH
7. SALINE MARSH
8. URBAN DEVELOPMENT

UNDEFINED AREAS — OPEN WATER

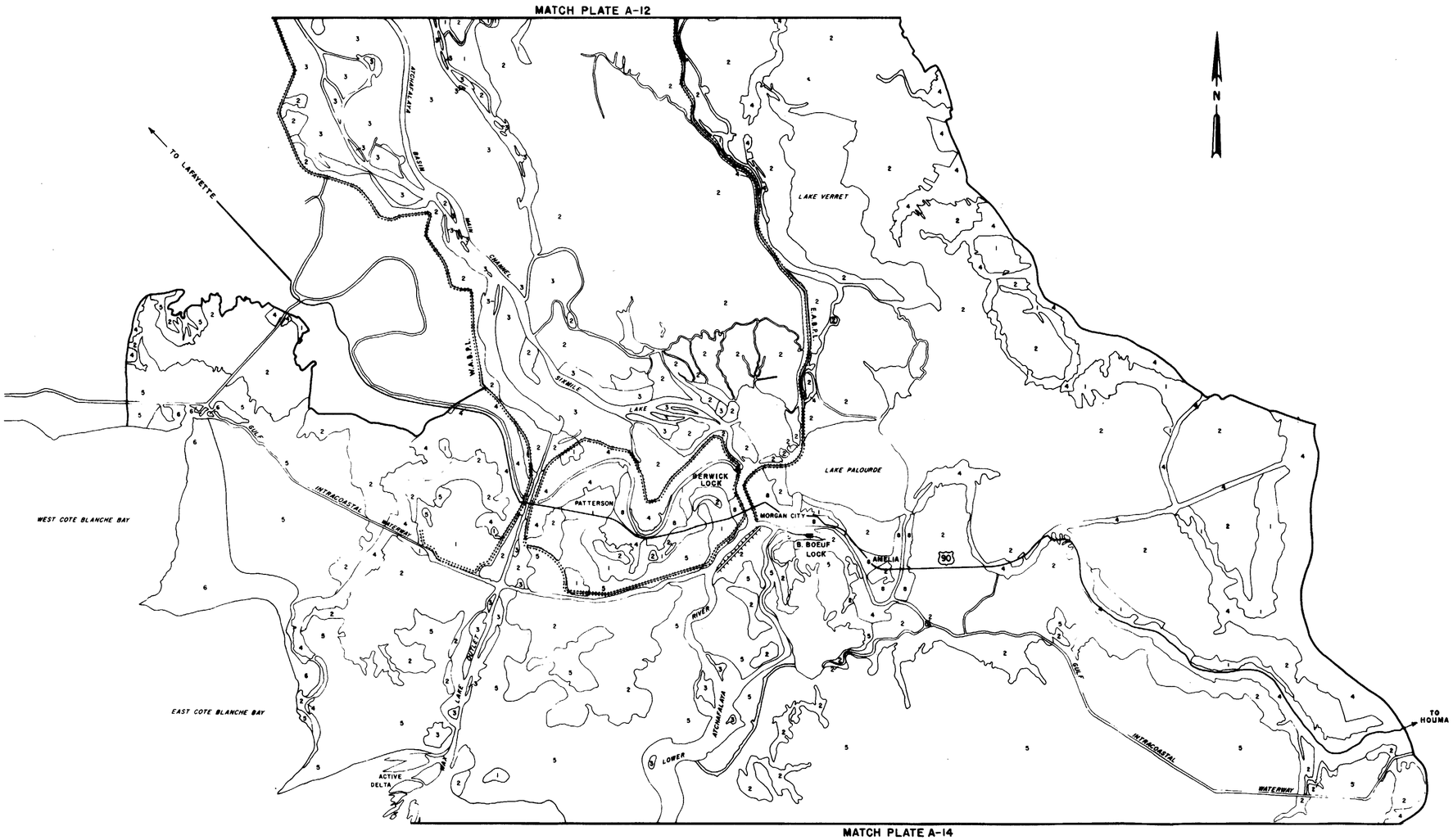
SCALE
0 1 2 3 4 5 Miles

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE A-13



LEGEND

1. MID TO LATE SUCCESSIONAL BOTTOMLAND HARDWOODS
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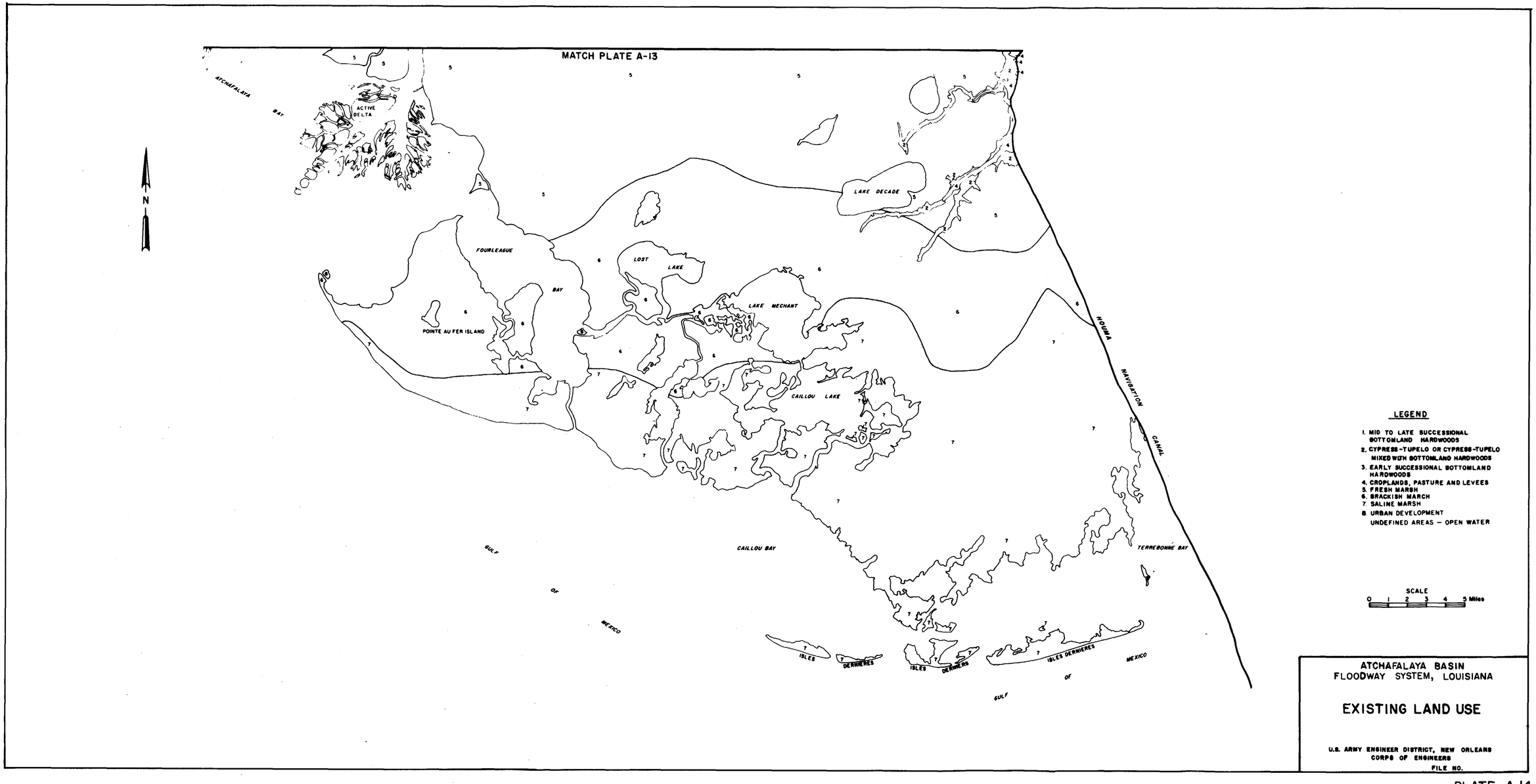
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE A-13



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE A-14

Section 5 - EXISTING CONDITIONS (PROFILE)

A.5.1. The study area is comprised of three interrelated components: the Red River backwater area; the Atchafalaya Basin Floodway system; and the Lower Atchafalaya River complex (the Terrebonne Parish marshes and backwater area northeast of Morgan City), including Atchafalaya Bay (Figure A-5-1). Located in south central Louisiana, the study area is about 200 miles long (north to south) and averages 40 miles in width (east to west).

A.5.2. The northernmost portion of the study area, the Red River backwater area, is situated north of Old River and encompasses parts of Avoyelles, Caldwell, Catahoula, Concordia, Franklin, Grant, LaSalle, Ouachita, Rapides, Richland, and Tensas Parishes. This area is subject to overflow from backwater originating from the Mississippi River for about 40 miles westward to the hills beyond Catahoula Lake. From the head of the Atchafalaya Basin Floodway and the south bank levee of the Red River, the backwater area extends about 100 miles north along the Ouachita and Tensas Rivers and their tributaries to the limits of overflow in the vicinity of Monroe. This backwater area is currently protected from Mississippi River headwater flooding by the west bank Mississippi River levee. Portions of the area are protected from Ouachita River headwater flooding by the east bank Ouachita River levee and, to a minor extent, from headwater flooding by the Red River levees below Moncla. Additionally, many areas are protected from flooding by local levee systems.

A.5.3. The Atchafalaya Basin comprises the southern portion of the study area. It is bounded by alluvial ridges that mark the positions of the meander belts of ancient Mississippi River courses (Plate A-3). The Teche Ridge forms the western and southern boundaries while alluvial ridges along Bayou des Glaises, the Atchafalaya River (from its head to Simmesport), and Lower Old River define the basin on the north. The eastern boundary is formed by ridges along the Mississippi River, extending from the head of Old River to Donaldsonville and by ridges flanking Bayou Lafourche from Donaldsonville to Houma. At Houma, the Lafourche ridge is built over the Teche Ridge, completely inclosing the basin. The basin extends in a southerly direction for more than 100 miles from the latitude of Lower Old River and Bayou des Glaises to Atchafalaya Bay and the Gulf of Mexico. The basin contains the Atchafalaya Basin Floodway system, which is leveed to form the West Atchafalaya, Morganza, and Lower Atchafalaya Basin Floodways (Plate A-2). The floodway levees parallel the Atchafalaya River and confine an average width of 15 miles from Simmesport to Morgan City which encompasses approximately 822,000 acres. Also, the Atchafalaya River is leveed from Simmesport to below Krotz Springs. Below the river levees, the basin is a wetland of national significance.

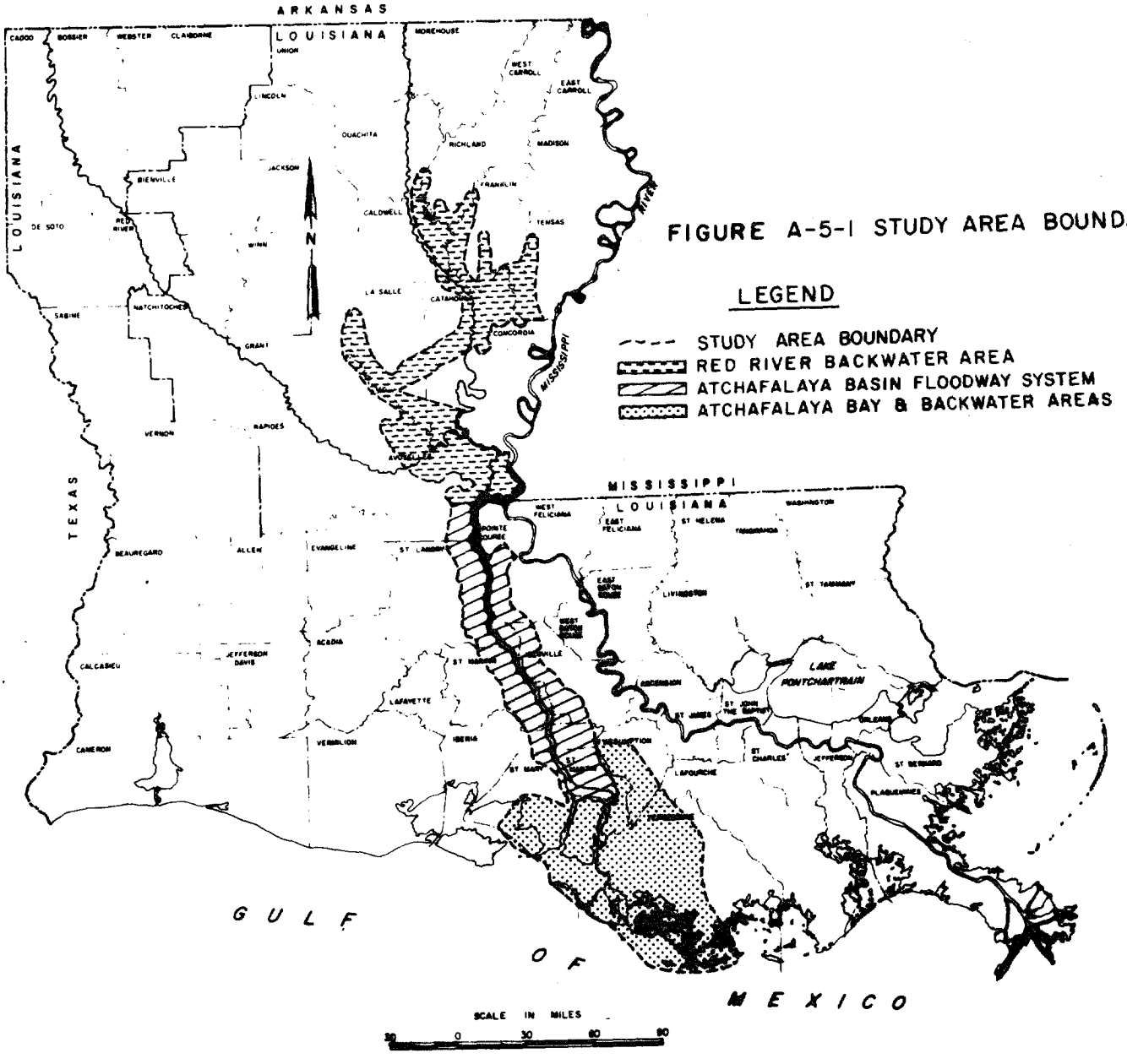


FIGURE A-5-1 STUDY AREA BOUNDARY

LEGEND

- STUDY AREA BOUNDARY
- RED RIVER BACKWATER AREA
- ATCHAFALAYA BASIN FLOODWAY SYSTEM
- ATCHAFALAYA BAY & BACKWATER AREAS

A.5.4. The Lower Atchafalaya River backwater complex to the east of the lower side of the Lower Atchafalaya Basin Floodway covers an area of about 1,100,000 acres, extending from just south of Baton Rouge to the Gulf of Mexico. The area is roughly bounded on the east by the Texas and New Orleans Railroad and the Houma Navigation Channel and on the west by the Lower Atchafalaya Basin Floodway. Portions of Iberville, Assumption, St. Martin, Lafourche, and Terrebonne Parishes are located in this area.

Characteristics of the Mississippi and Atchafalaya Rivers

GENERAL

A.5.5. During the years in which the Atchafalaya River had developed from a minor distributary into one which threatened capture of the Mississippi River, the US Army Corps of Engineers has maintained records that document its enlargement. Evaluations of these data are in several reports among which are the Mississippi River Commission's "Atchafalaya River Study" (May 1951) and "The Mississippi and Atchafalaya Rivers Below Old River In Relation to Human Settlement: 1718-Present" by the Institute of River Studies, University of Missouri-Rolla (in publication). The following paragraphs are intended only as a summary of the principal hydraulic data on the Atchafalaya River.

LENGTH

A.5.6. The Atchafalaya distributary from its head at the junction of the Old River segment with the Mississippi River to Atchafalaya Bay is 141 miles in length. During most of the year it reaches approximate sea level at Atchafalaya Bay 135 miles below its head. In contrast, the length of the Mississippi River below Old River is 332 miles to the mouth of Southwest Pass and 301 miles to Head of Passes (approximate sea level).

SLOPE

A.5.7. The average water surface slope of the Atchafalaya River has become progressively flatter with time, but is still a much steeper slope than that of the Mississippi River. Plate A-4 is a plot of the water surface profile of the Atchafalaya River from Simmesport to

Morgan City for a discharge of 240,000 cfs. Stage data at locations throughout the basin are published yearly in the US Army Corps of Engineers "Stages and Discharges Publication."

DISCHARGE

A.5.8. Discharge observations made in the Atchafalaya River at Simmesport are generally representative of the flow in the Atchafalaya Basin. Measurements made in the Mississippi River at Tarbert Landing are representative of the flow in the Mississippi River to the gulf. Since 1903, observations at Simmesport have recorded a maximum of 781,000 cfs, a mean of 211,000 cfs, and a minimum of 10,500 cfs. A tabulation of the total annual discharges since 1951 is shown in Table A-5-1. At Tarbert Landing the maximum discharge is 1,977,000 cfs, the mean is 454,000 cfs, and the minimum is 85,000 cfs. Table A-5-1 contains a tabulation of the annual discharges since 1949. Since 1900, the percent of latitude discharge in the Atchafalaya River has increased from 15 to just over 30 percent (Plate A-5). The Old River control structure now maintains this distribution at 30 percent on an annual basis.

A.5.9. Discharge measurements made in the Old River outflow channel since 1963 have resulted in a maximum of 610,000 cfs and a mean of 157,000 cfs. Table A-5-1 contains a tabulation of the annual discharge since 1965.

A.5.10. Flows entering the Atchafalaya River from the Red River are represented by measurements made at Alexandria. Since 1928, maximum discharge has been 233,000 cfs, the mean 31,700 cfs, and the minimum 873 cfs. Table A-5-1 contains the annual discharges since 1951.

A.5.11. Since 1975, discharge measurements have been made at four ranges in the Atchafalaya Basin Floodway. The ranges give an indication of the discharge leaving the main channel via the four major distributaries: the East and West Access Channels and the East and West Freshwater Distribution Channels. These stations are not rated ranges and, therefore, annual discharges are not available.

A.5.12. Discharges have been observed intermittently since 1927 in the Lower Atchafalaya River at Morgan City and since 1946 in Wax Lake Outlet at Calumet. The ranges are located near the Gulf of Mexico and are, therefore, subject to tidal influences. Attempts have been unsuccessful in trying to rate these two stations. The distribution of flow between the outlets is currently (1980) about 70/30 percent (Lower Atchafalaya River/Wax Lake Outlet).

TABLE A-5-1
SUMMARY OF TOTAL ANNUAL DISCHARGES
AT POINTS INFLUENCING ATCHAFALAYA RIVER INFLOW

WATER YEAR (OCT-SEP)	WATER YEAR DISCHARGES (1,000 DSF)			
	ATCHAFALAYA RIVER [1]	MISSISSIPPI RIVER [2]	OLD RIVER OUTFLOW CHANNEL [3]	RED RIVER [4]
1949-50		245,000		
1950-51		225,000		
1951-52	80,800	201,000		8,500
1952-53	57,000	142,000		12,600
1953-54	32,000	89,000		5,900
1954-55	50,400	137,000		7,300
1955-56	49,100	127,000		4,400
1956-57	74,100	173,000		16,800
1957-58	89,400	196,000		18,500
1958-59	55,700	129,000		6,800
1959-60	69,300	164,000		9,800
1960-61	76,800	168,000		12,700
1961-62	88,900	191,000		12,500
1962-63	47,100	105,000		5,000
1963-64	33,100	125,000		4,200
1964-65	66,400	150,000		6,800
1965-66	51,000	138,000	32,500	8,000
1966-67	57,300	132,000	45,000	6,800
1967-68	80,100	163,000	52,200	16,200
1968-69	83,300	168,000	59,300	14,800
1969-70	74,300	151,000	59,600	8,700
1970-71	71,700	148,000	56,400	4,900
1971-72	75,400	151,000	59,400	7,800
1972-73	140,000	266,000	102,000	17,900
1973-74	117,000	231,000	78,000	18,000
1974-75	117,000	204,000	70,500	22,500
1975-76	65,900	145,000	49,700	6,200
1976-77	47,800	113,000	30,600	8,500
1977-78	79,700	185,000	62,300	4,900
1978-79	104,800	244,000	67,800	13,100
AVERAGE	72,700	167,000	58,900	10,400

[1] At Simmesport, Louisiana.
[2] At Tarbert Landing, Mississippi.
[3] Near Knox Landing, Louisiana.
[4] At Alexandria, Louisiana.

CHANNEL WIDTH AND DEPTH

A.5.13. The increase in discharge through the Atchafalaya River is coupled with a corresponding increase in channel widths (Figures A-5-2 and A-5-3). Data also show a gradual increase through the years together with a smoothing out of some of the major irregularities in the channel bottom. The river channel decreases in area at the ends of the levees and is even more shallow in the Grand Lake-Sixmile Lake segment. South of Sixmile Lake, depths increase in the Lower Atchafalaya River, but become less as the river enters Bateman Lake and Atchafalaya Bay.

A.5.14. Channel widths in the Atchafalaya River have increased so that some areas show a channel width double that of 50 years ago. This trend of enlargement manifests itself along many reaches of the river by caving of opposite banks, a condition not observed on the Mississippi River where caving along an individual reach is usually confined to a single bank. Changes in channel area below the Low Water Reference Plane (LWRP) are shown in Figures A-5-4 and A-5-5 for the Atchafalaya River. Changes in channel widths and areas for the Mississippi River are shown in Figures A-5-6 through A-5-9.

Geology and Soils

FIELD INVESTIGATIONS

A.5.15. No soil borings were made specifically for this study of the Lower Atchafalaya Basin Floodway nor were any specific geologic field studies conducted. However, existing geologic publications, GDM's, boring data, and other available soils information from previous studies were reviewed for greater insight into geologic conditions to be encountered at the proposed and completed project sites within the Lower Atchafalaya Basin Floodway.

GENERAL SURFACE AND SUBSURFACE GEOLOGY

A.5.16. The general surface geology of the Atchafalaya Basin and a generalized geologic section taken eastward across the floodway from Franklin shows typical subsurface conditions encountered (Plates A-6 and A-7). That portion of the floodway north of the Teche Ridge is primarily a backswamp area deposited by overflow from various stream courses that have traversed the general area. However, from the vicinity of Krotz Springs southward, the backswamp deposits are covered by deltaic materials up to 25 feet in depth. Also, many

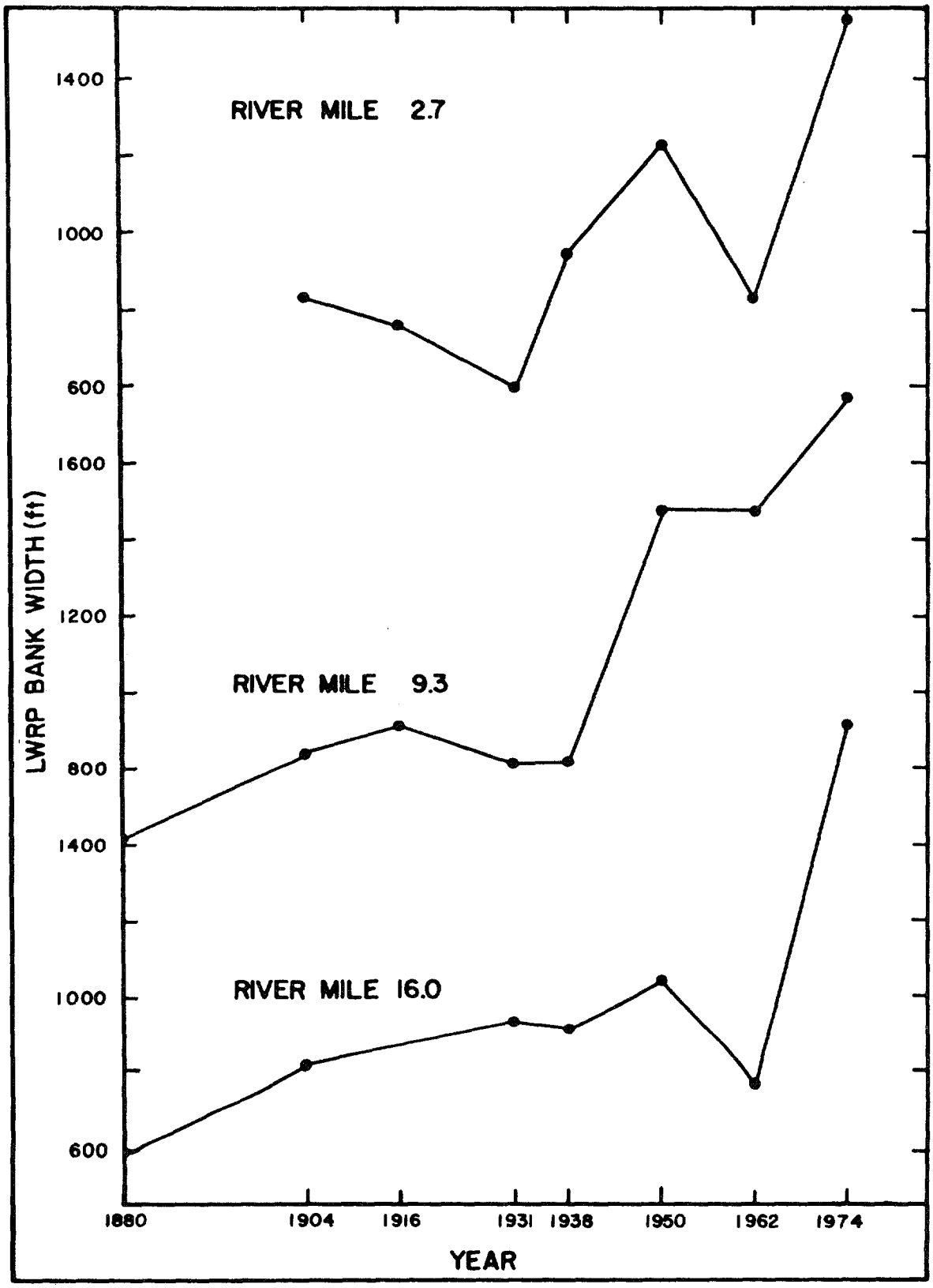


FIGURE A-5-2. LWRP bank widths of the Atchafalaya River at river miles 2.7, 9.3 and 16.0 between 1880 and 1974.

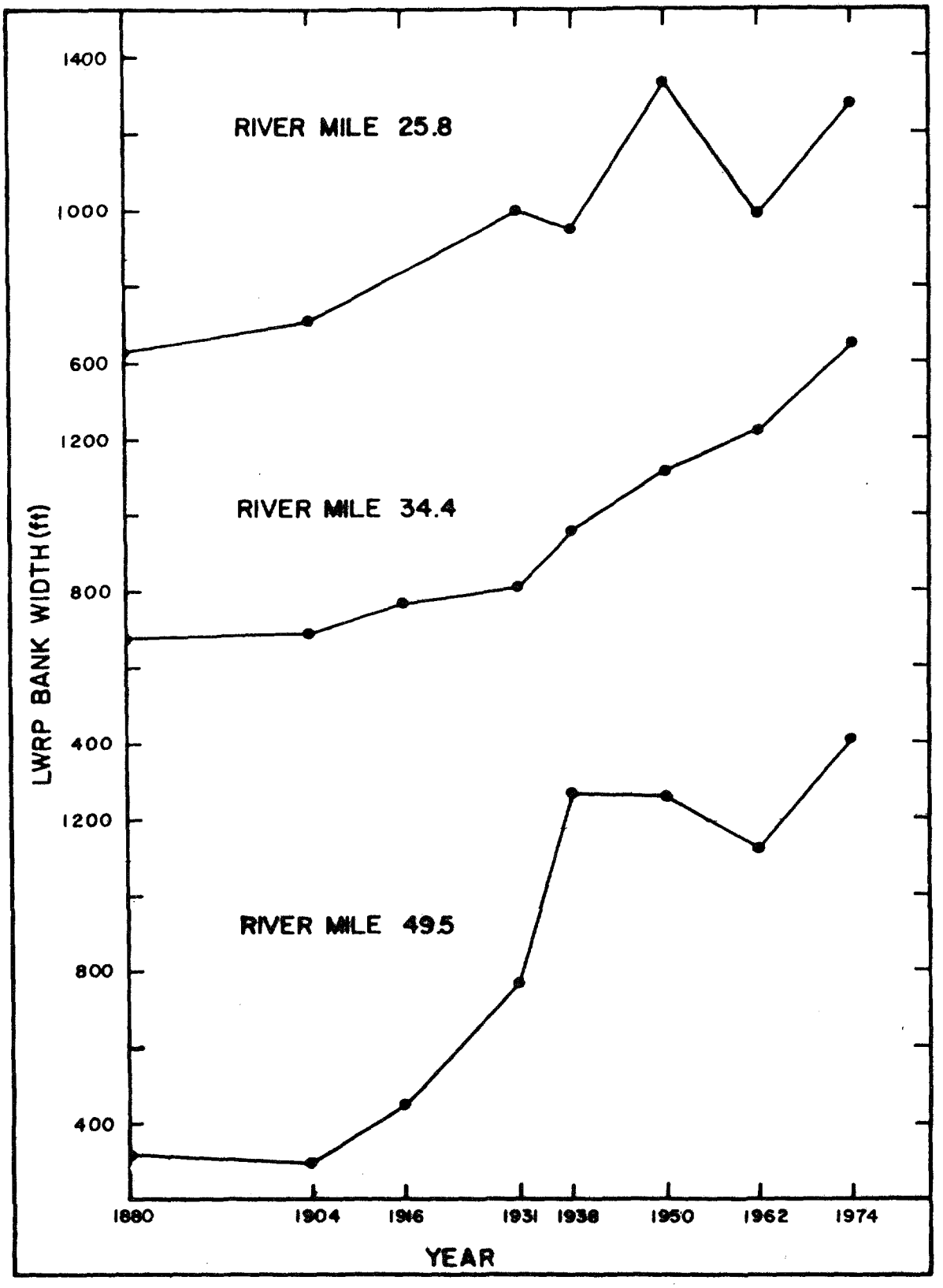


FIGURE A-5-3. LWRP bank widths of the Atchafalaya River at river miles 25.8, 34.4 and 49.5 between 1880 and 1974.

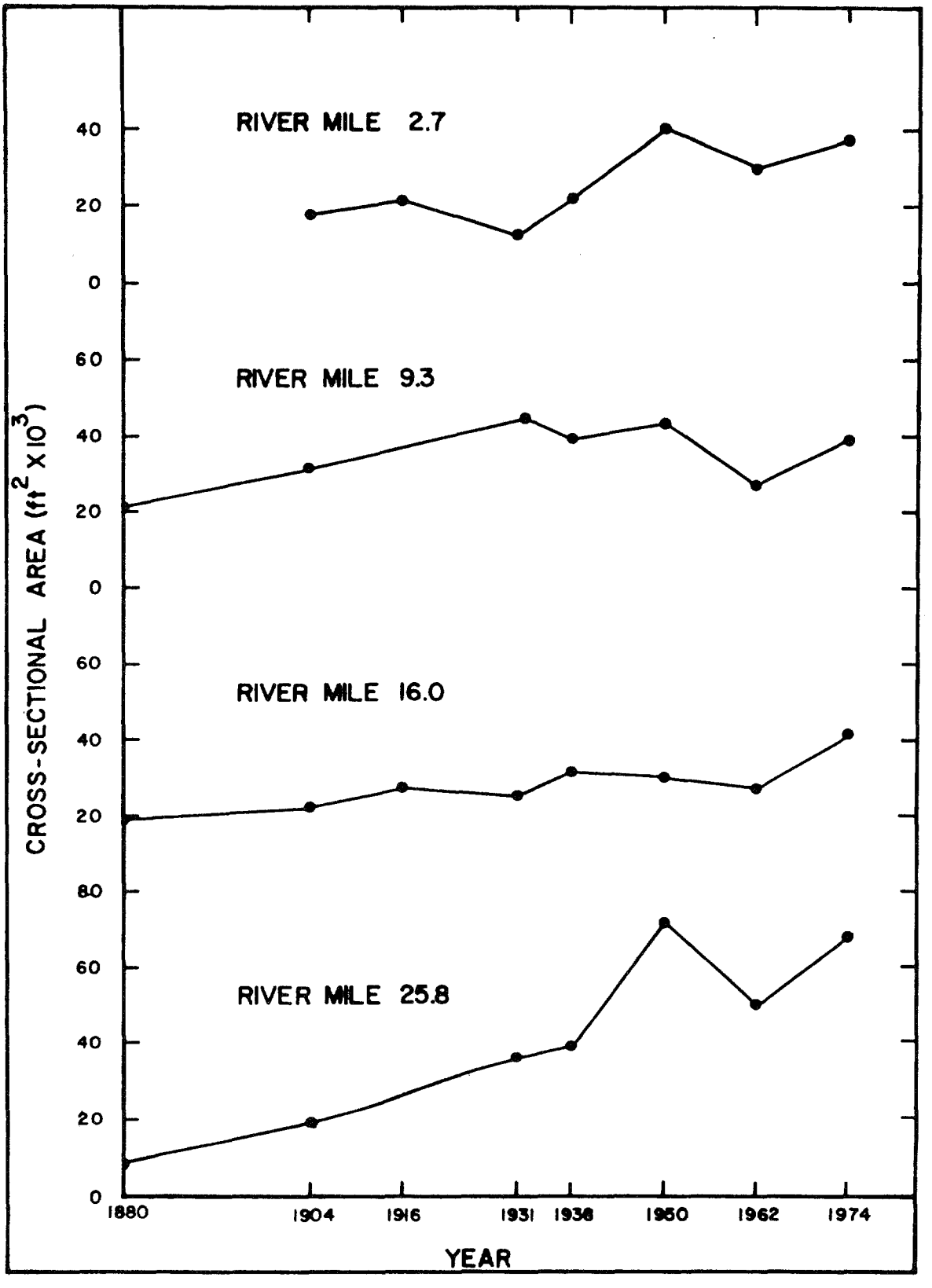


FIGURE A-5-4. LWRP area of the Atchafalaya River at river miles 2.7, 9.3, 16.0 and 25.8 between 1880 and 1974.

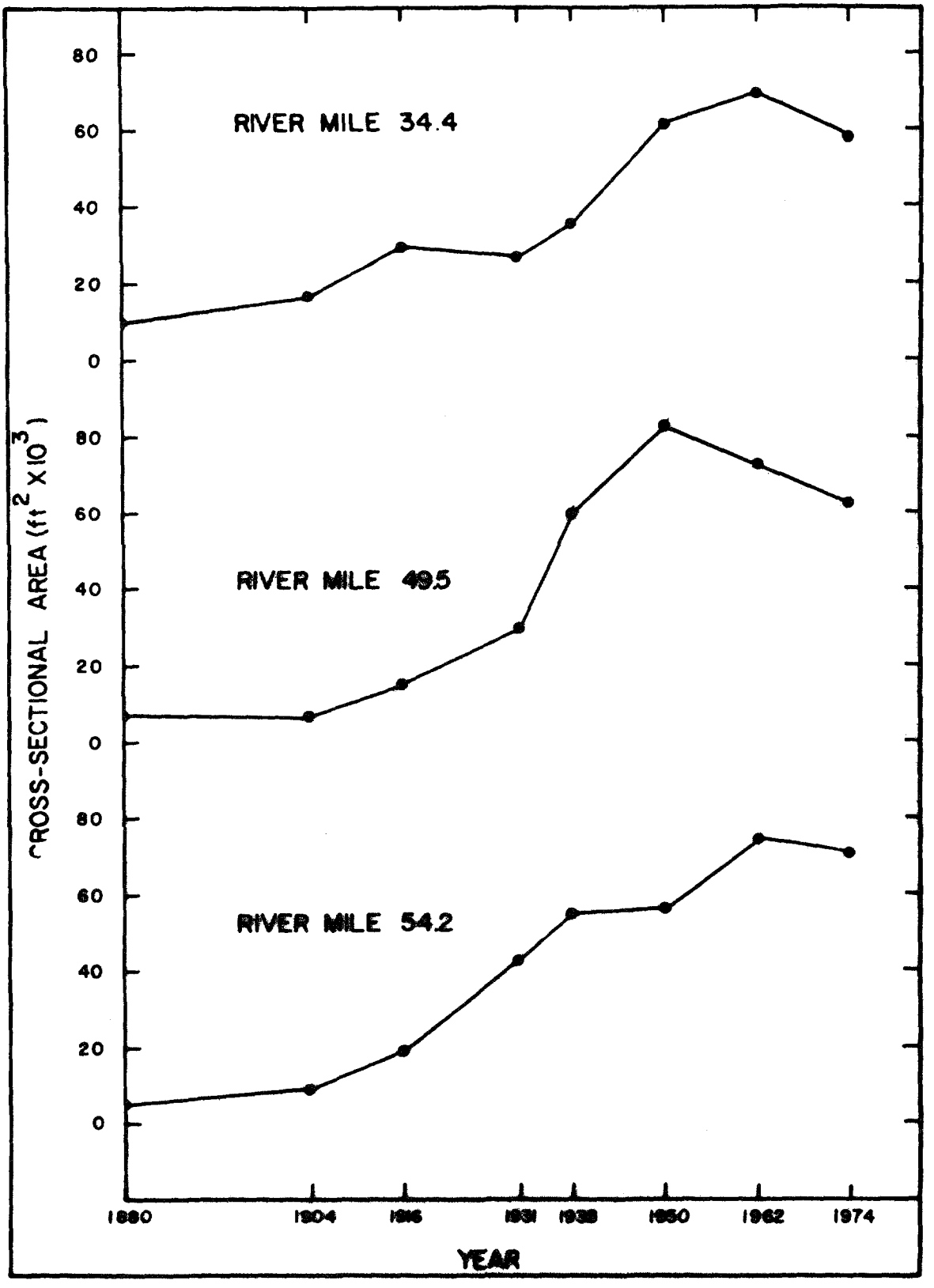


FIGURE A-5-5. LWRP area of the Atchafalaya River at river miles 34.4, 49.4 and 54.2 between 1880 and 1974.

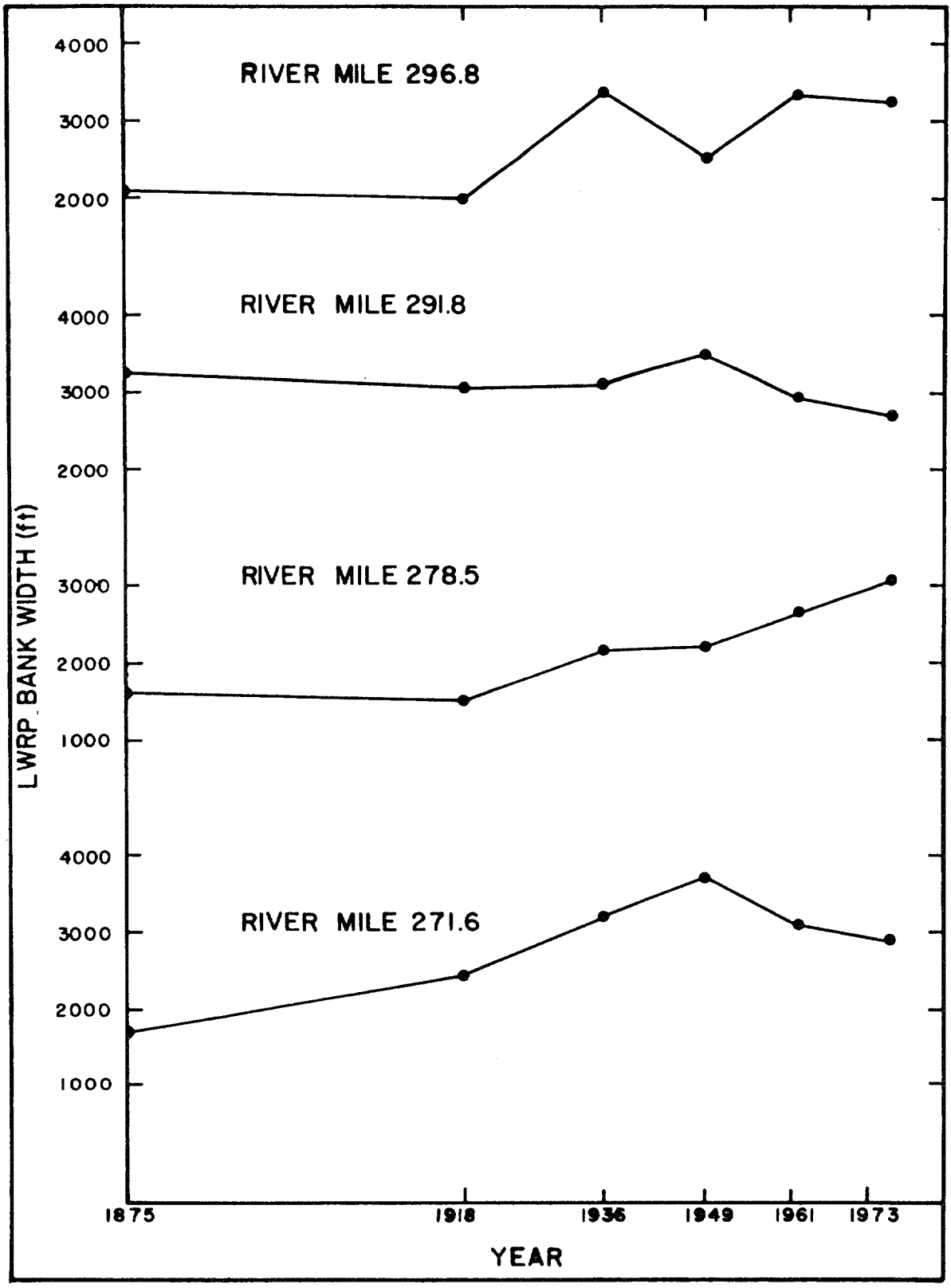


FIGURE A-5-6. LWRP bank widths of the Mississippi River at river miles 296.8, 291.8, 278.5 and 271.6 between 1875 and 1974.

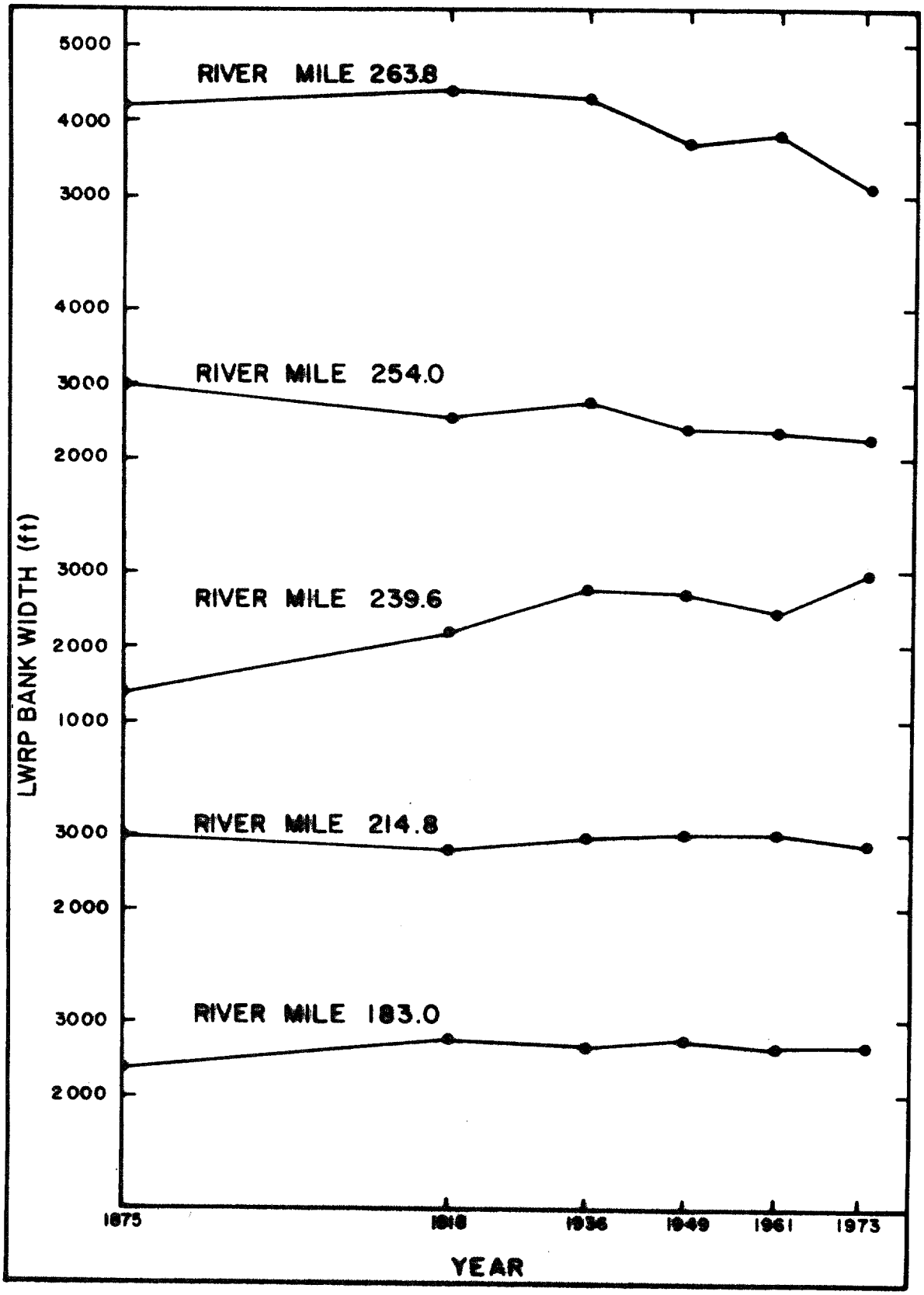


FIGURE A-5-7. LWRP bank widths of the Mississippi River at river miles 263.8, 254.0, 239.6, 214.8 and 183.0 between 1875 and 1974.

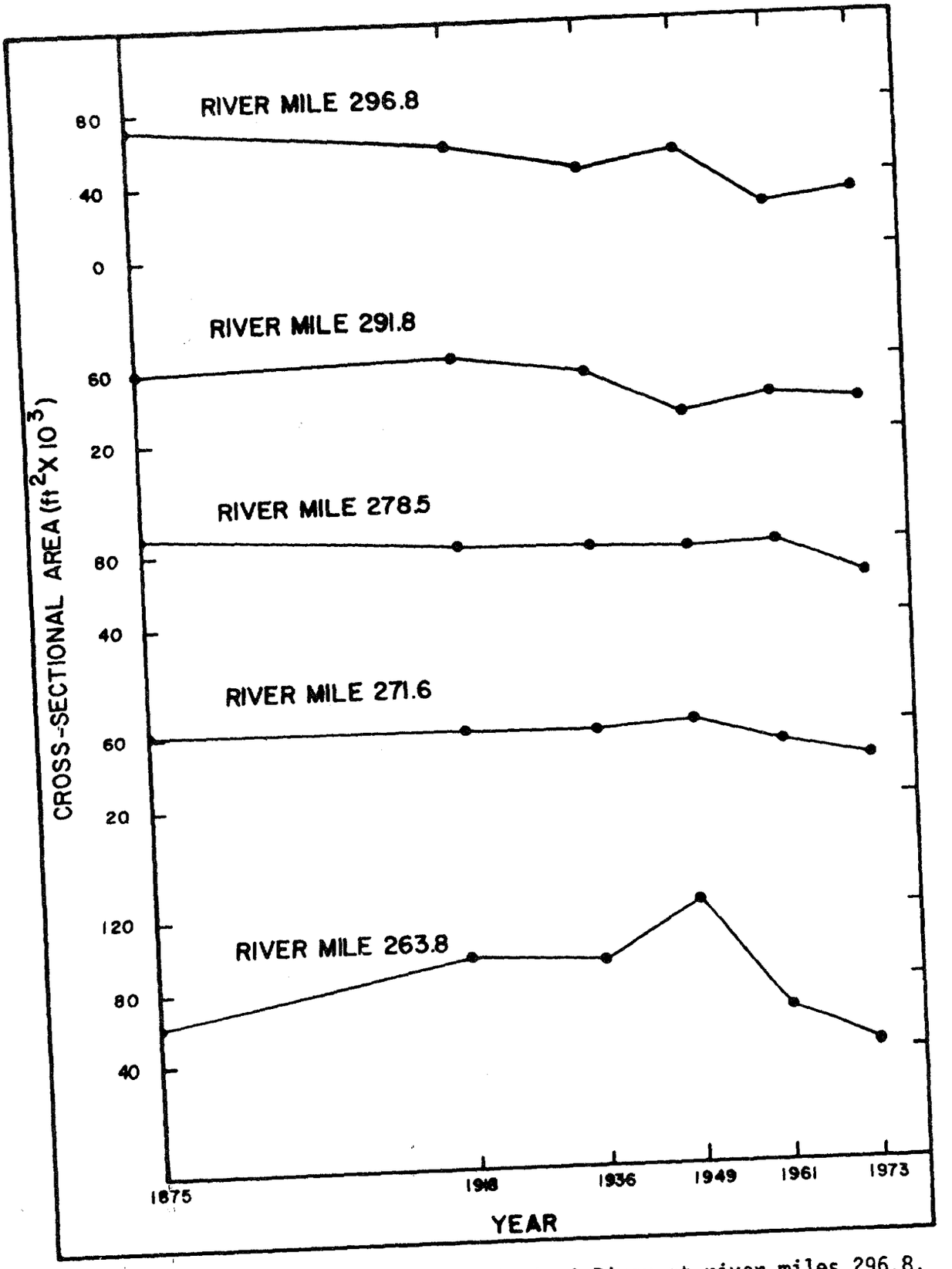


FIGURE A-5-8. LWRP area of the Mississippi River at river miles 296.8, 291.8, 278.5, 271.6 and 263.8 between 1875 and 1974.

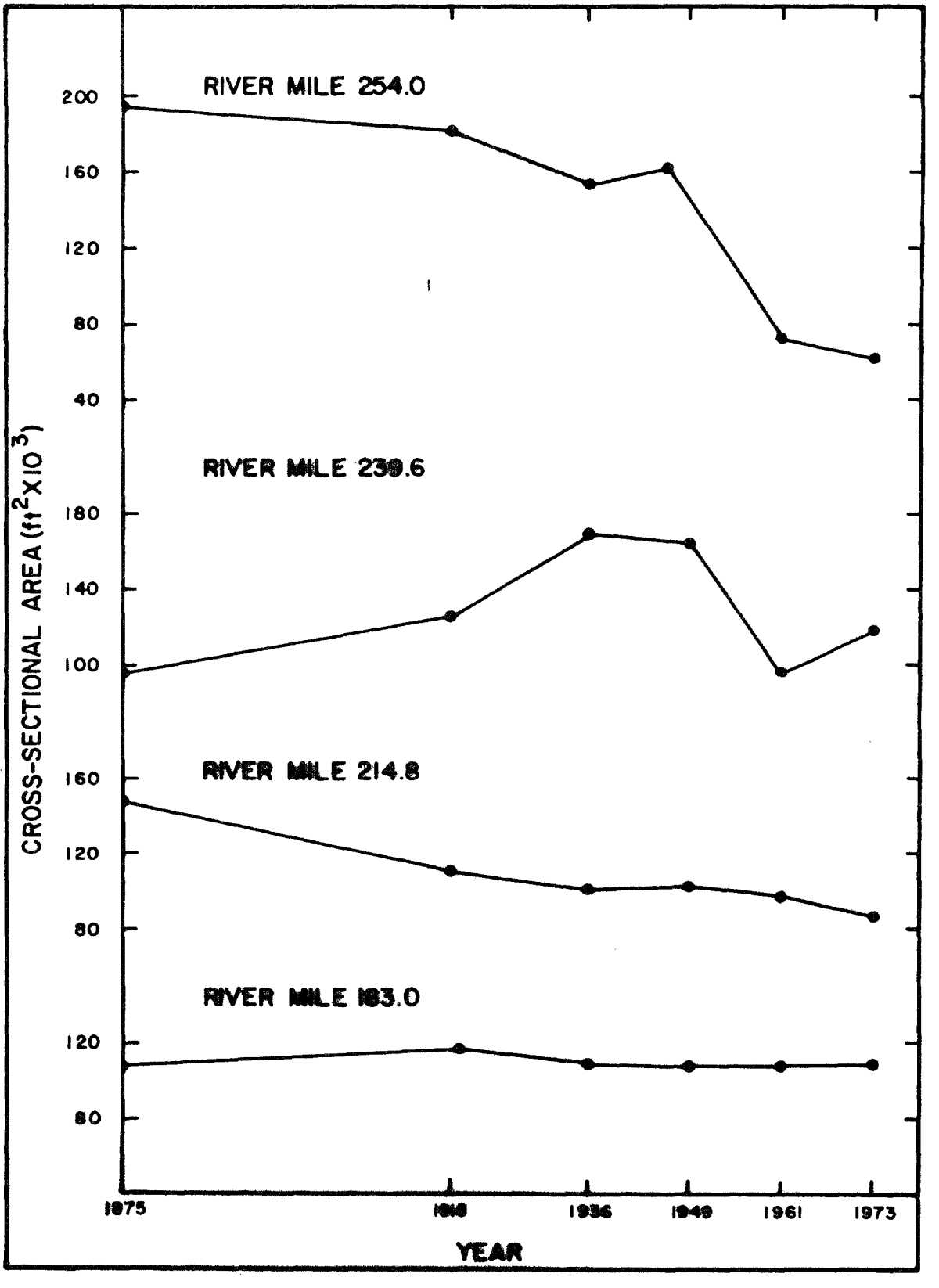


FIGURE A-5-9. LWRP area of the Mississippi River at river miles 254.0, 239.6, 214.8 and 183.0 between 1875 and 1974.

narrow areas of point bar and channel fill deposits are found where old channels established their meander belts.

A.5.17. At the northern end of the study area, along the lower Red River to the general vicinity of Simmesport, Holocene deposits are underlain directly by Tertiary age deposits of the Miocene series. From this point southward to the general vicinity of Melville, undifferentiated Pliocene-Miocene series deposits underlie the Holocene materials in a narrow east-west band across the basin. From Melville southward to the gulf, the Holocene is underlain by Pleistocene deposits that outcrop at the surface and flank each side of the Holocene alluvial valley to the latitude of Donaldsonville on the east and to Franklin to the west.

GEOLOGIC AND RELATED PROBLEMS (PAST, EXISTING, AND POTENTIAL)

A.5.18. One of the initial problems in using the Atchafalaya Basin as an efficient floodway was the need to improve the flow capacity of the lower basin by establishing one major low water channel. Dredging operations were initially conducted in 1932 for this purpose. This partially dredged channel is still developing as the overbank areas build up by sedimentation during high water flows.

A.5.19. As flow through the basin increased, the channel has enlarged to a sizable navigation and floodflow channel. The result was a notable increase in diversion of flow from the Mississippi River to the Atchafalaya River, because this route is considerably shorter to the gulf and has a distinct gradient advantage. By 1950 the rate of annual diversion from the Mississippi River was approaching 25 percent and by projecting a curve of annual diversion rates, it was found that by 1971, 40 percent of the Mississippi River flow would be diverted to the Atchafalaya River. The problem of diversion was initially solved by construction of the Old River control structure to enable flow control between the Mississippi and Atchafalaya Rivers.

A.5.20. Other than damage incurred by the Old River low sill structure during the 1973 flood, the major problems in maintaining the floodway and completing the necessary levees, structures, channels, and other features from a geologic viewpoint are subsidence, sedimentation, and river elongation due to delta development. These geologic processes are still occurring as they have in the past. Increased sedimentation actually accelerates subsidence; the sedimentation effects of recent floods are visible immediately after floodwaters pass to the gulf. Regional subsidence occurs somewhat more slowly as sedimentation increases. River elongation increases the height of the flowline within the lower portions of the project area.

A.5.21. Changes in water levels over time have been observed along the Louisiana gulf coast. The changes, called apparent sea level rise, are the result of true sea level rise and land subsidence caused by basement sinking from the sediment load, consolidation of sediments of the gulf coast geosyncline, local consolidation, and tectonic activity. In the area of the Atchafalaya delta, the water levels are very much affected by the deltaic activity incident to the maturation of the Atchafalaya River. The effect of true sea level rise is difficult to evaluate, but is generally considered to be less than 0.2-foot per century. It is likewise difficult in the Atchafalaya delta to determine how the apparent change in sea level is distributed between subsidence and increased hydraulic gradient. Subsidence rates vary considerably with geologic time, and changes caused by deltaic activity are dependent on the hydrologic conditions in the Atchafalaya delta. The rate of change in apparent sea level can vary between 0 and 3 feet per century, depending on the location considered and the method used to determine the rate. Based on geologic investigations subsidence is greatest along the coastline with the rate decreasing with distance inland. The rates determined by geologic methods are generally less than those determined by recent methods which use statistical analysis of water surface elevations. The latter methods ignore the fact that change in the hydraulic characteristics of the system affects the stages.

LOCAL SETTLEMENT

A.5.22. Settlement of the earth levees constructed in the basin in some reaches has exceeded 20 feet. The near-surface portion of the backswamp deposits, which form the foundation for most of the protection levee system, are highly compressible. Some areas contain thick deposits of peat, decayed wood, and highly organic clays with water contents greater than 200 percent by volume not unusual. These clays consolidate tremendously under loading as water is squeezed from them, and when loaded too severely, will fail. Soil profiles and settlement data for the large protection levees are shown in Plates A-8 through A-11. These data delineate the areas where foundation soils are poorest and settlement has been most severe.

Sediment

A.5.23. Regular suspended sediment and bed material measurements have been made on the Mississippi, Red, and Atchafalaya Rivers since 1949. Measurements have been made on the Old River outflow channel since 1965. Bed material measurements, other than at the suspended sediment sampling ranges, were made infrequently prior to 1971. Sediment measurements made in 1929 and 1932 similar to the recent

measurements have been published in "Paper H" and "Paper U" of the US Waterways Experiment Station. Measurements made since 1950 are available but unpublished. Summaries of the annual sediment loads are presented in Tables A-5-2 through A-5-5. Since 1950, measurements in the Mississippi River at Tarbert Landing have recorded a maximum of 3,740,000 tons/day; a mean of 218,000 tons/day; and a minimum of 20,000 tons/day. Measurements in the Atchafalaya River at Simmesport since 1951 have recorded a maximum suspended load of 2,120,000 tons/day; a mean of 108,000 tons/day; and a minimum of 2,100 tons/day. Old River sediment loads measured near Knox Landing since 1965 have been recorded to be 82,700 tons/day maximum; 52,500, average; and 19,300, minimum. Since 1951, measurements in the Red River at Alexandria have recorded a maximum suspended load of 2,020,000 tons/day; a mean of 36,500 tons/day; and a minimum of 220 tons/day. Measurements have been made since 1975 at the four main distributaries in the Atchafalaya Basin Floodway. The ranges of the east and west access channels and the east and west freshwater distribution channels are not rated but are used to indicate the amount of sediment leaving the main channel.

Climatology

TEMPERATURE

A.5.24. Lower Basin. Records for seven stations located in or adjacent to the lower basin (Donaldsonville, Houma, Morgan City, Paincourtville, Plaquemine, Schriever, and Thibodaux) were obtained from "Climatological Data" for Louisiana published by the National Weather Service. The minimum temperature of 3 degrees Fahrenheit (°F) was recorded at Donaldsonville on 13 February 1899. The maximum temperature of 105°F occurred at Schriever on 18 August 1909. The seasonal normal temperatures vary from 56°F in winter to 82°F in summer. Temperature normals for the stations in Donaldsonville, Houma, and Morgan City indicate that the average annual temperature is 69°F. Normal monthly temperatures in degrees Fahrenheit are given below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
54.4	57.0	62.0	69.0	75.8	80.8	82.2	82.1	78.7	70.5	61.2	56.2

A.5.25. Upper Basin. The annual normal temperature for this area is 68°F and the recorded extremes for Melville are 5°F, 13 February 1899, and 105°F, 9 August 1935. Seasonal normal temperatures range from 53°F in winter to about 81°F in summer. The normal monthly temperatures are given below (based on readings taken at Melville, Louisiana).

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
51.8	54.6	60.1	68.3	74.4	79.9	81.7	81.4	77.0	68.0	58.9	53.6

TABLE A-5-2

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
LOWER MISSISSIPPI RIVER AT TARBERT LANDING, MISSISSIPPI [1/]

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND Sand (in 1,000 tons)	SAND (%)	SILT Silt (in 1,000 tons)	SILT (%)	Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
1949-50	548,000	108,000	20	440,000	80	245,000	828
1950-51	575,000	67,000	12	508,000	88	225,000	947
1951-52	408,000	74,000	18	334,000	82	201,000	754
1952-53	212,000	29,000	14	183,000	86	142,000	552
1953-54	108,000	14,000	13	94,000	87	89,000	449
1954-55	211,000	40,000	19	171,000	81	137,000	570
1955-56	161,000	26,000	16	135,000	84	127,000	468
1956-57	291,000	53,000	18	238,000	82	173,000	624
1957-58	326,000	95,000	29	231,000	71	196,000	616
1958-59	231,000	79,000	34	152,000	66	129,000	660
1959-60	318,000	77,000	24	241,000	76	164,000	718
1960-61	231,000	71,000	31	160,000	69	168,000	510
1961-62	264,000	94,000	36	170,000	64	191,000	512
1962-63	101,000	24,000	24	77,000	76	105,000	353
1963-64	121,000	18,000	15	103,000	85	125,000	361
1964-65	203,000	41,000	20	162,000	80	150,000	502
1965-66	174,000	46,000	26	128,000	74	138,000	469
1966-67	111,000	15,000	14	96,000	86	132,000	312
1967-68	155,000	36,000	23	119,000	77	163,000	353
1968-69	155,000	39,000	25	116,000	75	168,000	343
1969-70	149,000	49,000	33	100,000	67	151,000	364
1970-71	181,000	75,000	41	106,000	59	148,000	456
1971-72	152,000	48,000	32	134,000	68	151,000	373
1972-73	227,000	75,000	33	152,000	67	266,000	316
1973-74	197,000	48,000	24	149,000	76	231,000	316
1974-75	164,000	40,000	24	124,000	76	204,000	300
1975-76	115,000	20,000	18	95,000	82	145,000	294
1976-77	81,000	10,000	12	71,000	88	113,000	265
1977-78	173,000	34,000	20	139,000	80	185,000	340
1978-79	194,000	54,000	28	140,000	72	244,000	295
Average	218,000	50,000	23	168,000	77	167,000	484

[1/] Sampling at Baton Rouge before Mar 1958 and at Red River Landing between Mar 1958 and June 1963.

[2/] The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction included all of the fine material passing the No. 230 sieve.

TABLE A-5-3

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
ATCHAFALAYA RIVER AT SIMMESPORT, LOUISIANA

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND Sand (in 1,000 tons)	SAND (%)	SILT RATIO 1/ Silt (in 1,000 tons)	SILT (%)	Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
1951-52	196,000	49,000	25	147,000	75	80,800	900
1952-53	135,000	28,000	21	107,000	79	57,000	880
1953-54	54,100	13,000	24	41,000	76	32,000	627
1954-55	93,400	24,100	26	69,300	74	50,400	686
1955-56	67,200	15,500	23	51,700	77	49,100	507
1956-57	225,000	55,000	25	170,000	75	74,100	1,126
1957-58	214,000	48,000	22	166,000	78	89,400	887
1958-59	83,200	20,900	25	62,300	75	55,700	553
1959-60	132,000	24,000	18	108,000	82	69,300	704
1960-61	133,000	40,000	30	93,000	70	76,800	643
1961-62	152,000	58,000	38	94,000	62	88,900	633
1962-63	44,900	8,600	19	36,300	81	47,100	353
1963-64	52,600	10,400	20	42,200	80	33,100	588
1964-65	109,000	28,000	25	81,000	75	66,400	607
1965-66	88,500	17,500	20	71,000	80	51,000	642
1966-67	55,700	6,800	12	48,900	88	57,300	360
1967-68	121,000	16,000	14	105,000	86	80,100	561
1968-69	115,000	27,000	24	88,000	76	83,300	512
1969-70	75,100	19,800	26	55,300	74	74,300	374
1970-71	72,400	19,600	27	52,800	73	71,700	374
1971-72	89,600	18,700	21	70,900	79	75,400	440
1972-73	124,000	45,000	36	79,000	64	140,000	329
1973-74	143,000	32,000	23	111,000	77	117,000	453
1974-75	158,000	35,000	22	123,000	78	117,000	499
1975-76	56,100	8,500	15	47,600	85	65,900	315
1976-77	57,100	6,000	11	51,100	89	47,800	443
1977-78	71,200	12,500	18	58,700	82	79,700	331
1978-79	112,300	25,500	23	86,800	77	104,800	346
Average	108,000	25,000	23	83,000	77	72,700	550

1/ The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction includes all of the fine material passing the No. 230 sieve.

TABLE A-5-4

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
OLD RIVER OUTFLOW CHANNEL NEAR KNOX LANDING, LOUISIANA

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND		SILT	RATIO 1/		Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
		Sand (in 1,000 tons)	(%)	Silt (in 1,000 tons)	(%)			
1965-66	33,100	5,900	18	27,200	82		32,500	378
1966-67	37,300	8,300	22	29,000	78		45,000	307
1967-68	49,900	13,000	26	36,800	74		52,200	354
1968-69	62,900	14,100	22	48,800	78		59,300	393
1969-70	63,000	15,700	25	47,300	75		59,600	414
1970-71	70,500	24,100	34	46,400	66		56,400	438
1971-72	56,800	16,700	29	40,100	71		59,400	355
1972-73	82,700	25,800	31	56,900	69		102,000	301
1973-74	60,900	16,300	27	44,500	73		78,000	289
1974-75	50,000	10,100	20	39,900	80		70,500	262
1975-76	34,800	6,000	17	28,800	83		49,700	259
1976-77	19,300	1,400	7	17,900	93		30,600	234
1977-78	62,600	14,600	23	48,000	77		62,300	372
1978-79	51,200	9,700	19	41,500	81		67,800	280
Average	52,500	13,000	25	39,600	75		58,900	330

1/ The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction includes all the fine material passing the No. 230 sieve.

TABLE A-5-5

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
RED RIVER AT ALEXANDRIA, LOUISIANA

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND Sand (in 1,000 tons)	(%)	SILT RATIO 1/ Silt (in 1,000 tons)	(%)	Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
1951-52	39,600	6,500	16	33,100	84	8,500	1,730
1952-53	43,800	11,900	27	31,900	73	12,600	1,290
1953-54	16,500	3,100	19	13,400	81	5,900	1,030
1954-55	21,800	3,600	16	18,200	84	7,300	1,100
1955-56	13,400	2,200	17	11,200	83	4,400	1,130
1956-57	82,400	17,000	21	65,400	79	16,800	1,820
1957-58	95,600	15,300	16	80,300	84	18,500	1,910
1958-59	13,600	4,200	31	9,400	69	6,800	730
1959-60	31,900	6,200	20	25,700	80	9,800	1,200
1960-61	47,000	12,200	26	34,800	74	12,700	1,360
1961-62	45,600	10,900	24	34,700	76	12,500	1,350
1962-63	9,800	2,600	26	7,200	74	5,000	730
1963-64	10,600	1,500	14	9,100	86	4,200	940
1964-65	23,100	4,000	18	19,100	82	6,800	1,250
1965-66	29,700	6,200	21	23,500	79	8,000	1,370
1966-67	16,200	3,200	20	13,000	80	6,800	880
1967-68	71,200	16,400	23	54,800	77	16,200	1,630
1968-69	64,200	16,700	26	47,500	74	14,800	1,610
1969-70	28,200	8,200	29	20,000	71	8,700	1,200
1970-71	6,600	2,200	33	4,400	67	4,900	500
1971-72	34,900	6,700	19	28,200	81	7,800	1,670
1972-73	52,300	13,000	25	39,300	75	17,900	1,080
1973-74	77,000	19,900	26	57,100	74	18,000	1,580
1974-75	81,400	16,900	21	64,500	79	22,500	1,340
1975-76	7,400	1,100	15	6,300	85	6,200	442
1976-77	20,100	2,200	11	17,900	89	8,500	876
1977-78	8,600	2,200	26	6,400	74	4,900	650
1978-79	28,800	4,800	17	24,000	83	13,100	811
Average	36,500	7,900	22	28,600	78	10,400	1,300

1/ The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction includes all of the fine material passing the No. 230 sieve.

PRECIPITATION

A.5.26. Lower Basin. Records of eight stations located in or adjacent to the watershed were obtained from "Climatological Data" for Louisiana published by the National Weather Service. The maximum daily rainfall of 14.5 inches was recorded at Donaldsonville on 25 August 1926. The maximum monthly rainfall of 22.7 inches occurred at Morgan City in September 1943. All stations recorded months with no measurable rainfall, the most recent being Donaldsonville, Houma, Morgan City, and Schriever in October 1963. The maximum annual rainfall of 111.3 inches occurred at Morgan City in 1946, and the minimum of 33.0 inches was recorded at Houma in 1899. Precipitation normals for the stations at Carville, Houma, and Morgan City, indicate that the average annual rainfall is 62 inches. The mean monthly rainfall is given below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.5	4.8	4.9	4.4	4.8	5.7	7.7	6.5	6.6	3.2	4.0	5.2

A.5.27. An intense thunderstorm produced the greatest rainfall of record, 15.6 inches at Morgan City, 16-17 April 1927. Other storms produced heavy rainfall amounts as follows: 7.4 inches on 24 April 1900; 8.0 inches, 8 October 1905; 7.3 inches, 18 April 1914; 6.7 inches, 15 April 1927; 9.7 inches, 18-19 September 1943; 6.1 inches, 29 March 1949; 5.4 inches, 8 June 1959; and 4.4 inches, 6 September 1967. In addition, hurricanes have produced rainfall as follows: 8.5 inches (estimated) on 30 September 1915; 8.0 inches, 25 August 1926; 4.9 inches, 2 October 1937; 6.5 inches, 7 August 1964; and 5.6 inches, 10 September 1965.

A.5.28. Upper Basin. Based on records from the National Weather Service at Simmesport and Melville, the normal annual precipitation is 57 inches. Normal monthly rainfall ranges from 3.1 inches in October to 5.9 inches in December. Monthly normals are given below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.4	5.1	5.5	5.3	5.7	4.4	5.0	4.1	3.8	3.1	4.1	5.9

A.5.29. The maximum monthly and annual rainfall for this area is 29.52 inches (May 1953) and 82.98 inches (1961), respectively. The minimum monthly and annual rainfall for the area is 0.0 inches (October 1963) and 33.3 inches (1924), respectively.

EVAPORATION

A.5.30. Measures of evaporation have been collected at Rice Experiment Station, Crowley, Louisiana, for the period 1910-1949.

During this period the annual evaporation varied from a maximum of 66.5 inches to a minimum of 41.6 inches. Monthly evaporation showed a maximum of 8 inches in July-August 1947 and a minimum of 1.4 inches in January 1911. The average monthly evaporation in inches is as follows.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2.3	2.7	3.8	4.8	6.0	6.2	5.9	5.8	5.2	4.5	3.0	2.4

A.5.31. In addition to the summaries given above for the lower and upper portions of the basin, the following summary is for the major lakes in the area.

Lake	Annual Precipitation	Lake Evaporation
Cocodrie	62 inches	48 inches
Fausse Pointe	60 inches	50 inches
Grand, Sixmile, and Flat	66 inches	49 inches
Opelousas Bay (Henderson)	58 inches	49 inches
Palourde	66 inches	49 inches
Verret	66 inches	49 inches

Biological Resources

A.5.32. Since the majority of the actions considered in this document are concentrated in the Lower Atchafalaya Floodway, the backwater area northeast of Morgan City, and the coastal marshes, the following discussions will focus on these areas and briefly address the other features of the project. The presentation discusses terrestrial and aquatic resources in terms of the flora, fauna, and ecological relationships which exist for each of the major land-use types situated in the area. This approach was chosen because of the vastness of the region and the consequential diversity of topographic, edaphic, and biotic characteristics encountered.

A.5.33. Historically, the higher alluvial flood plains of the northern portions of the project area have supported extensive stands of bottomland hardwoods. These forests are composed of several vegetative associations due to varied and complex soil and moisture conditions. Flood control measures and increased prices for farm products have induced conversion of bottomland hardwood forests into agricultural lands. Croplands, pastures, and levees form a major habitat type in the project area. In the southern portion of the project area and in the backwater area northeast of Morgan City, cypress-tupelo communities are present in low-lying areas subject to a prolonged hydroperiod (period of inundation). Extensive coastal

marshes border the project area along the Gulf of Mexico. In the natural process of river and flood plain development, these vegetative types encroach gulfward as deposition of sediment increases elevations and extends delta formation downstream, and river channel enlargement lowers water levels upstream. The other significant vegetative type in the project area, early successional bottomland hardwoods, predominates on newly accreted lands. This forest serves as a transition stage which, with time and increases in land elevation, will succeed to mature bottomland hardwoods. Table A-5-6 shows the major terrestrial habitat types in the project area and the acreage of each for the specified locations.

A.5.34. Aquatic systems of the project area are as diverse as the terrestrial. In the upper reaches of the area where river levees prevent annual overflow, the streams, bayous, and lakes are generally dependent on rainfall or backwater induced by flood stages in the lower portion of the area. Habitat diversity and productivity increase in areas to the south where there is overbank flooding and in the coastal marshes. Table A-5-7 exhibits aquatic habitat types and the acreage of each for the locations indicated.

A.5.35. The project area is dynamic. Natural and man-induced factors make it a continually changing system. As the Atchafalaya River main channel matures, areas which were previously overflowed at frequent intervals become less subject to overbank flows as a result of sedimentation and stage reduction. These processes and the activities of man have effected changes which keep the aquatic ecosystem transitory. System modifications which have contributed significantly to this dynamic state are clearing for agriculture, mineral exploitation, commercial forestry, flood control, and navigation programs.

A.5.36. In addition to describing the terrestrial and aquatic resources that are present in the project area, the discussions include a comparison of the relative value of the various habitat types as reflected by the USFWS Habitat Evaluation Procedures (HEP) and the US Army Corps of Engineers Habitat Evaluation System (HES). Plates A-12, A-13 and A-14 delineate existing land uses for the study area below the latitude of Krotz Springs.

Terrestrial Resources

EARLY SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.5.37. General. Approximately 93,900 acres of early successional bottomland hardwood forests exist in the project area; 91,200 acres

TABLE A-5-6

EXISTING TERRESTRIAL HABITAT

Habitat Type	1975 ACRES				1980 ACRES		Total
	Red River Backwater Area	West Atchafalaya Floodway	Simmesport, Melville, and Krotz Springs	Morganza Floodway	Lower Atchafalaya Basin Floodway [1]	Areas Outside the Floodway System [2]	
Mid-to-Late-Successional Bottomland Hardwood Forest	391,000	108,000	--	39,000	247,000	85,000	870,000
Cypress-Tupelo Swamp	29,000	--	--	1,000	176,000	275,000	481,000
Early Successional Bottomland Hardwood Forest	--	--	--	--	91,200	2,700	93,900
Early Successional Bottomland Hardwood Forest Mixed with Cypress-Tupelo	--	--	--	--	8,400	--	8,400
Cleared Land	354,000	60,000	--	17,000	16,400	80,800	528,200
Fresh Marsh	--	--	--	--	--	323,000	323,000
Brackish Marsh	--	--	--	--	--	89,400	89,400
Saline Marsh	--	--	--	--	--	108,000	108,000
Urban	1,000	--	2,000	--	--	5,300	8,300
Active Delta	--	--	--	--	--	10,100	10,100
TOTAL	775,000	168,000	2,000	57,000	539,000	979,300	2,520,300

[1] Includes the area bounded by a line one-quarter mile west of the WABPL north of Verdunville and a line one-quarter mile east of the EABPL north of Bayou Sorrel.

[2] Includes all lands outside the protection levees south of Verdunville on the west side and the Lower Atchafalaya River backwater complex.

TABLE A-5-7

EXISTING AQUATIC HABITAT (1980 ACRES)

Habitat Type	1975 ACRES				1980 ACRES		Total
	Red River Backwater Area	West Atchafalaya Floodway	Simmesport, Melville, and Krotz Springs	Morganza Floodway	Lower Atchafalaya Basin Floodway [1]	Areas Outside the Floodway System [2]	
Riverine, Distributary, or Open-ended Canal	27,000	--	--	--	23,000	8,100	58,100
Freshwater Bayou or Slow-flowing Canal	12,000	1,000	--	--	15,900	22,100	51,000
Headwater Lake	--	--	--	--	18,200	--	18,200
Backwater Lake	36,000	1,000	--	--	13,800	28,200	79,000
Cropland Lake	6,000	--	--	--	--	--	6,000
Fresh Marsh Pond and Lake	--	--	--	--	--	87,600	87,600
Fresh Bay	--	--	--	--	--	200,000	200,000
Brackish Marsh Pond and Lake	--	--	--	--	--	55,200	55,200
Brackish Bayou or Canal	--	--	--	--	--	6,200	6,200
Brackish Bay	--	--	--	--	--	58,900	58,900
Saline Marsh Pond or Lake	--	--	--	--	--	64,400	64,400
Saline Bayou or Canal	--	--	--	--	--	6,100	6,100
Saline Bay	--	--	--	--	--	53,800	53,800
Shallow Gulf	--	--	--	--	--	804,000	804,000
TOTAL	81,000	2,000	--	--	70,900	1,548,500	1,535,500

[1] Includes the area bounded by a line one-quarter mile west of the WABPL north of Verdunville and a line one-quarter mile east of the EABPL north of Bayou Sorrel.

[2] Includes all lands outside the protection levees south of Verdunville on the west side and the Lower Atchafalaya River backwater complex.

within the Lower Atchafalaya Basin Floodway, and 2,700 acres in the backwater area northeast of Morgan City. This association occurs in conjunction with newly accreted land or recently disturbed areas and propagates in the presence of bare mineral soils and in settings which lack overhead shade and competition from other nearby vegetation (Putnam et al., 1960; Fowells, 1965, and Johnson, 1973). This forest type can be found throughout the basin and intermixed with cypress-tupelo in former swamp areas which no longer experience long hydroperiods. Largest concentrations of early successional bottomland hardwood forests are evident in the Grand and Sixmile Lakes area (Plate A-13). The islands in these lakes provide a nucleus for trapping sediment which is conducive to accelerating the production of land with surface elevations well above the low water elevations during the growing season. These areas are in primary stages of forest succession and are undergoing rapid changes in terms of species composition of the floral community. Eventually, late successional bottomland hardwood forests will develop and occupy the areas. The present community in the Grand and Sixmile Lake area consists of several dominant overstory species with a shade tolerant understory that is constantly being changed by annual floods. This vegetation type does not represent a quality habitat for most species of wildlife, but is heavily utilized by certain seasonally-abundant species such as the yellow-rumped warbler (Kennedy, 1977) or by white-tailed deer when basin water levels are low (Evans, 1976).

A.5.38. Overstory. The three dominant tree species that occur in the early successional bottomland hardwood association are cottonwood, willow and sycamore. These may occur as pure stands or as a mixture. Willows are quite water and sediment tolerant and are vigorous invaders of a newly accreted site (Teskey and Hinckley, 1977). Cottonwoods appear to invade somewhat drier sites than willows and may be succeeded by sycamore, hackberry, and American elm. Other trees often found in this community include boxelder, Drummond red maple, roughleaf dogwood, cypress, and ash.

A.5.39. Understory. Cottonwood, willow, and sycamore are not shade tolerant and their seedlings will not establish under a closed overstory (Fowells, 1965). This factor is responsible for the change of this community to mid-successional bottomland hardwoods. The understory of the early successional community is sparse where the tree crowns are closed, particularly in young, dense stands. Well-developed understory is limited to older stands that have become thinned through age and maturation. The thinner mature stands allow light penetration and support shrubs, vines, herbaceous plants, and grasses. This species association has the lowest diversity of woody understory of all habitats in the basin and the second lowest herbaceous understory diversity. Percent ground cover is midway between that of swamp and late successional bottomland hardwoods (McClanahan, 1975). Typical shrubs are waxmyrtle, leadplant, and button bush. Common vines include Virginia creeper, poison ivy, peppervine, trumpet

creeper, and ladies' eardrops. Common herbs or semiwoody plants are goldenrod, blackberry, false nettle, cockelbur, St. Johnswort, lizard's tail, smartweeds, horsetails, beggar's ticks, and thoroughworts.

A.5.40. Commercial Forestry Potential. During the early stages of development of this community, pulpwood production represents the major forest product, although lack of access limits its harvest in much of the basin. Maturation of the cottonwood and sycamore stands results in the availability of quality saw timber. Even after attaining saw timber diameter, however, willow is still considered a poor-quality product. Cottonwood is used for pulp, matches, boxes, and crates. Willow is used for boxes, crates, and other wooden ware. Sycamore wood is used for veneer, trim paneling, boxes, crates, and concealed parts of furniture.

A.5.41. Mammals. The carrying-capacity of early successional bottomland hardwoods for most species of forest wildlife is inferior to that of mature bottomland hardwoods but higher than that of cypress-tupelo. The white-tailed deer is the most common big game species inhabiting this region while the swamp rabbit is the major small game species. Various small game and furbearing species like the fox, bobcat, opossum, and raccoon also use this habitat. In terms of nongame mammals, this habitat type has a lower species diversity than mature bottomland hardwoods. Some of the more common species present include the eastern mole, the armadillo, and the hispid cotton rat. The lack of mast and browse probably accounts for the low carrying-capacity and species diversity. The early successional community is inferior to both bottomland hardwood and cypress-tupelo communities in furbearer production. It is not preferred as a trapping area, but established populations of raccoon, nutria, opossum, and some beaver do exist there. Additional information concerning the mammals of this habitat type may be found in Nichols (1971), Evans (1976), Heuer (1976), and Hebert (1977).

A.5.42. Birds. A thorough study of the bird populations of the basin was made by Kennedy (1977). Efforts were concentrated on the early successional communities on the banks of the Atchafalaya River main channel and did not include the extensive areas of this association in the lower basin. The results of the study indicated that the early successional community supports the second greatest diversity of major forest types in the Atchafalaya Basin. It is the preferred habitat for about 10 species of warblers, vireos, owls, sparrows, and tanagers and an acceptable habitat for the American woodcock. Nine species, common or abundant in the basin, include the white-throated sparrow, ruby-crowned kinglet, tufted titmouse, red-eyed vireo, and prothonotary warbler. Early successional communities located along the water courses in areas susceptible to annual flooding provide protective habitat and resting sites for migratory waterfowl but do not provide quality food. However, during peak migratory periods (April, August and September) and low-flow years, migrant species

utilize these areas. Because of considerable overflow during normal years, more attractive habitat is available and prompts the use of early successional communities.

A.5.43. Reptiles and Amphibians. The early successional community has the second greatest diversity of these animals of the major habitat types in the study area. Fifty-seven species may be expected to use this forest type (Keiser, 1976). Of the 21 species of salamanders, frogs, and toads present in the basin, 18 may be expected to occur here. Of the 45 species of lizards, snakes, turtles, and the alligator present, 39 may be expected to occur. Thus, this habitat is of major importance for this animal group. Additional detailed data on the herpetofauna of the basin can be obtained from the report by Keiser (1976).

A.5.44. Invertebrates. The early successional bottomland hardwood forest type furnishes habitat for most of the common groups of invertebrates. Protozoans, nematodes, mosquitoes, moths and butterflies, dragonflies, buck flies, bees and wasps, beetles, snails, spiders, ticks, and mites are all common. These animals play a vital role in the food web because many are eaten by other invertebrates, fish, amphibians, reptiles, birds, and mammals. Many of these animals are herbivorous while others are scavengers of dead plant and animal matter. Some are biting pests of man and other animals.

A.5.45. Value as Aquatic Habitat. At the present time, approximately 73,300 acres of early successional bottomland hardwoods in the Lower Atchafalaya Basin Floodway are flooded during an average year. While flooded, these areas function as aquatic habitat and are utilized as spawning, nursery, and forage areas by numerous species of fish and shellfish. The submerged litter and ground cover begin to decay and to be surrounded by a halo of bacteria and fungi (detritus) and becomes a vital part of the aquatic food web.

MID-TO-LATE SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.5.46. General. The mid-to-late successional bottomland hardwood forests of the project area are typical of the hardwoods of the Mississippi River flood plain and are predominantly located in the Red River backwater area, the Morganza and West Atchafalaya Floodways, the backwater area northeast of Morgan City and on the elevated ridges in the Lower Atchafalaya Basin Floodway. These natural ridges have formed along bayous as a result of regular overbank flooding and deposition of silt. Generally, they occur as very narrow banks on small bayous, but are quite extensive along larger bayous and along the Atchafalaya River. These ridges commonly support vegetation similar to the drier bottomland hardwood areas north of Interstate Highway 10 (I-10). However, in the southernmost part of the study area some of

these natural ridges have subsided and eroded to the extent that they will no longer support trees. Bushy thickets of eastern baccharis and waxmyrtle usually take over here. Along many bayou ridges in the Belle River area there are dead or dying live oaks caused by high water levels. There are approximately 870,000 acres within the project area while within the Lower Atchafalaya Basin Floodway there are 247,000 acres, and in the backwater area northeast of Morgan City there are 85,000 acres. Mixed hardwood associations vary according to species tolerance to soil types and intermittent flooding conditions. However, all species in this forest type are able to tolerate at least infrequent flooding of short duration. The arrangement of the vegetation, which varies from dense to open stands, produces a diversified habitat with adequate food and cover capable of sustaining high populations of different forms of wildlife. Of the various vegetative communities in the basin, the mid-to-late successional bottomland hardwoods are the most productive in terms of commercial forest products and wildlife.

A.5.47. Overstory. Diversification in terms of species composition of the overstory is greatest in this habitat type. The better drained silty loams in the northern parts of the study area support an oak-dominated overstory with the common species being water oak, willow oak, American elm, and sweetgum. The more poorly drained soils support primarily bitter pecan, overcup oak, Nuttall oak, Drummond red maple, and various ashes. On the high, well drained soils along the Atchafalaya River one finds sycamore, hackberry, willow, cottonwood, and boxelder. Throughout the area covered by this habitat type, scattered cypress may be found.

A.5.48. Understory. The understory of this association is comprised typically of seedlings of the overstory species and a variety of shrubs, vines, and herbaceous cover. This habitat type has the most diverse woody understory of all habitat types in the basin. The more common shrubs on better drained sites include snowbell, deciduous holly, waxmyrtle, palmetto, and various hawthorns. On poorly drained sites, water elm and swamp privet occur and on certain sites within the Henderson Lake area where water is artificially impounded, these species may form an almost impenetrable thicket that prevents the growth of a ground cover due to the dense shade. The dominant vines include poison ivy, Virginia creeper, peppervine, rattan vine, and various greenbriars. Herbaceous cover is the most diverse in any habitat type in the basin with butterweed, lizard's tail, shield fern, oak forest grass, false nettle, yankeeweed, asters, elephant's foot, and smartweeds being among the most common species.

A.5.49. Commercial Forestry Potential. Several areas in the basin are logged for timber products such as hardwood lumber, veneer logs, pilings, poles, commercial posts, and pulp. The bulk of the volume harvested from mature bottomland hardwoods is provided by oaks and ashes. However, a number of other species are taken, including

American elm, bitter pecan, boxelder, Drummond red maple, cottonwood, hackberry, sweetgum, and sycamore.

A.5.50. Mammals. The white-tailed deer is the major big game species within the mid-to-late successional bottomland hardwood community (carrying-capacity for game species is discussed subsequently in this section). Black bears are found in certain portions of this area but not in sufficient numbers to be considered a major big game species. Rabbits and squirrels are the most common small game species within the area (Heuer, 1976). Mid-to-late successional bottomland hardwood forests contain the greatest species diversity and numbers of nongame mammals because of the amount of food and cover available (Heuer, 1976). Furbearers, such as coyotes and hybrid dog-coyotes, have also become fairly common in recent years. Some of the more common species include various bats, the armadillo, marsh rice rat, hispid cotton rat, and eastern wood rat. These forests support the greatest density of small mammals of any habitat type in the basin (Hebert, 1977). Although none of these animals are of sport or commercial importance, they are a vital part of the food web. The various rats and mice are especially important because of their abundance. These areas have good potential for fur production but are not heavily trapped. A study conducted by Nichols (1973) indicated that these areas support a higher population of mink and raccoon than the remainder of the basin. Additional information on the mammals of this habitat type may be found in the references previously cited in the section on early successional bottomland hardwood forests.

A.5.51. Birds. Mid-to-late successional stage bottomland hardwood forests have the greatest bird species diversity in the Atchafalaya Basin, as well as the highest numbers of individuals per unit area (Kennedy, 1977). In all months except April, August, and September, more species utilize these bottomlands than any other habitat type. These forests are the preferred habitat for approximately 40 species of woodpeckers, flycatchers, thrushes, wrens, and warblers. Fifteen species are common to abundant, including the red-bellied woodpecker, Acadian flycatcher, cardinal, Carolina wren, Carolina chickadee, and parula warbler. The presence of mast-producing trees coupled with the overflow regimen makes this region potentially a very valuable waterfowl wintering area. Although this area may winter as many as 20 different species of waterfowl, the mallard and the wood duck are most common. In addition to its importance as a wintering area, this region is an extremely important production area for breeding populations of wood ducks, probably due to the availability of nesting cavities and brood-rearing habitat. This region of the basin winters one of the largest concentrations of woodcock in North America (Glasgow and Noble, 1974, and Evans, 1976). The hardwood forests are used primarily for cover and feeding during the day while at dusk, large concentrations of these birds move from the forested areas to open fields. Since its reintroduction into the basin in the mid-1960s, the wild turkey has expanded its range to include the area

north of I-10, as well as areas south of I-10 near Butte LaRose. The previously cited study by Kennedy (1977) provides additional information on the bird populations of this habitat type.

A.5.52. Reptiles and Amphibians. Keiser (1976), in his study of the herpetofauna of the basin, reported that 61 species occur in the mid-to-late successional bottomland hardwood forest type. This includes 20 out of a basin-wide total of 21 species of salamanders, frogs, and toads, and 41 out of a basin-wide total of 45 species of lizards, snakes, turtles, and the alligator. Only nonagricultural open land habitats, such as levees, contained an equal number of species. Due to its large areal extent within the basin, the mid-to-late successional bottomland hardwood forest type is, therefore, of major importance as habitat for this animal group, particularly where it is not subjected to excessively long hydroperiods, but where it does contain some permanent water bodies.

A.5.53. Invertebrates. Mid-to-late successional bottomland hardwood forests have an abundance of invertebrates of all types due to the presence of a well-developed ground cover, understory, and overstory vegetative layers in many areas within this habitat type. Interspersion of the vegetative community with the many water bodies of the basin further enhances the opportunities for invertebrate species to live.

A.5.54. Value as Aquatic Habitat. Mid-to-late successional bottomland hardwoods are valuable to fishery resources because they provide detritus as well as feeding, spawning, and nursery habitat when flooded. Approximately 128,000 acres in the Lower Atchafalaya Basin are flooded during an average year.

CYPRESS-TUPELO SWAMPS

A.5.55. General. The most extensive swamps are located on the southeast side of the basin between Flat Lake and the east Atchafalaya Basin access channel as well as east of the lower floodway between Lake Verret and Houma (Plates A-12 and A-13). The cypress-tupelo region is very flat and much of it remains inundated for about 6 or more months of the year. Water from a few inches to several feet in depth normally covers the area from late fall or early winter (November-January) until early summer (May-June). The vegetative associations vary from a mixed stand of various water tolerant species to a monotype of cypress or tupelo. In drier areas, bottomland hardwood species may occur intermixed with the cypress and tupelo. South of Morgan City, a maple-willow zone occurs at the transition between swamp and marsh. Pockets of maple-willow or cypress-tupelo also occur within the marsh. These habitats are favorable for wildlife populations that are aquatic-oriented at some stage in their

lives. The cypress-tupelo swamps are generally considered to be less productive for wildlife than the mid-to-late successional bottomland hardwood forests, but more productive than the early successional community (see subsequent discussion in this section for habitat unit values). Approximately 481,000 acres of this habitat type occur in the project area; 176,000 of these acres are in the Lower Atchafalaya Basin Floodway and 275,000 acres are in the backwater area northeast of Morgan City. Because they are flooded for a portion of each year, these swamps are also a part of the aquatic ecosystem. Since swamps were studied by the Louisiana State University Cooperative Fishery Research Unit (Bryan, et al., 1974, 1975, and 1976) during their aquatic characterization of the floodway, the role of swamps in the aquatic system is discussed in a subsequent section.

A.5.56. Overstory. In comparison to the bottomland hardwoods, species diversity is greatly reduced in the swamps due to the greater frequency and duration of flooding. Cypress and tupelo dominate the swamp vegetation with pumpkin ash, green ash, Drummond red maple, and black willow also present (Hoffman, 1973; Fowells, 1965; US Department of the Interior, 1974; and O'Neil et al. 1975). Black willows invade cypress-tupelo areas where the canopy is open and sedimentation has reduced depth and duration of standing water. As water levels drop, other bottomland hardwood species also invade. Deeply flooded swamps that never dry will eventually convert to open water while swamps that dry occasionally may convert to a shrub swamp dominated by buttonbush, water elm, and swamp privet. In the transition zone south of Morgan City, the overstory consists of a mixture of Drummond red maple and black willow.

A.5.57. Understory. Both cypress and tupelo are fairly intolerant of shade and require considerable light for seedling development, as well as exacting water condition. Accordingly, seedlings of these two dominant overstory species occur sparingly in the understory. Woody understory in the swamp is much more sparse than in bottomland hardwoods but ground cover or herbaceous species such as water hyacinth, smartweeds, alligatorweed, arrowheads, lizards's tail, duckweed, and spiderlily do occur. Water hyacinth may completely cover the swamp floor in many locations. Common woody understory shrubs include buttonbush, water elm, and swamp privet. Vines are not abundant in this habitat type. In the maple-willow swamps south of Morgan City, various fresh marsh species occur as understory.

A.5.58. Commercial Forestry Potential. A large portion of the cypress-tupelo acreage supports a potential for present and future timber production. Since most of the cypress are 50-70 years old, they are approaching marketable age. Cypress represents, by far, the majority of the volume of timber harvested from the swamp. Both cypress and tupelo are lumbered for veneer logs, furniture, and other timber products. Cypress is used for making handmade shakes, fence-posts, construction timbers, siding, greenhouse and hotbed lumber,

interior trim, fancy paneling, window frames, doors, furniture, and fine cabinet construction (Brown, 1945). Since tupelo is a softwood, it is used primarily for interior trim.

A.5.59. Mammals. The absence of hard mast producing trees and the rather sparse understory (except for water hyacinth), caused by the depth and duration of inundation, greatly limit the carrying-capacity of this community for game species. Carrying capacities of this region are generally lower than in mid-to-late successional bottomland hardwood forests. Squirrels are present in population densities directly proportional to the quality of the overstory. Swamps have a lower species diversity than bottomland hardwoods. Some of the more common nongame mammals include various bats and the southern flying squirrel. These animals, although not of sport or commercial value, play a vital role at many levels of the food web. The cypress-tupelo community is heavily utilized by beaver, nutria, mink, and raccoon. This region is the most frequently trapped area of the basin. A study conducted by Nichols (1973) indicated that success for nutria was highest in this area. Additional information on the mammals of this habitat type may be found in the references cited in the section on early successional bottomland hardwood forests.

A.5.60. Birds. The cypress-tupelo swamps serve as extremely important breeding and production areas for wood ducks. Areas within the cypress-tupelo community that do not contain standing water but which possess moist soils provide feeding areas that are utilized by woodcock. Dense stands of shrubby understory vegetation, sometimes associated with this community, provide daytime resting areas for woodcock throughout the fall and winter. Cypress-tupelo swamps that maintain permanent standing water provide an attractive habitat to wintering waterfowl. The better areas within this community, however, are those that regularly dry up and allow seed producing annuals to invade. The quality of such areas is generally comparable to that of regularly inundated bottomland hardwoods. Cypress-tupelo swamps have the lowest bird species diversity of the major forest types in the Atchafalaya Basin. Within this community, the greatest diversity and numbers usually occur in the winter. These swamps are the preferred habitat for approximately 15 species of herons, egrets, ibises, vireos, flycatchers, warblers, and the anhinga. Only four species (the barred owl, the Carolina chickadee, and the prothonotary and parula warblers) are common to abundant in swamps. Several rookeries have been located in the Atchafalaya Basin. All occur in stands of mixed-age cypress with swamp privet and buttonbush in the understory. The species using these rookeries include anhingas, herons, egrets, and ibises. Kennedy (1977) provides additional information regarding the bird populations of this habitat type.

A.5.61. Reptiles and Amphibians. Cypress-tupelo swamps exhibit a lower species diversity of reptiles and amphibians than the bottomland hardwood communities. Keiser (1976) reported 51 species in this

habitat type. He found 18 species of salamanders and frogs out of a total of 21 amphibian species present in the basin and 33 species of lizards, snakes, turtles, and the alligator out of a total of 45 reptiles present in the basin as a whole.

A.5.62. Invertebrates. Baldcypress-tupelogum swamps furnish habitat for a large number of invertebrate species, especially those spending all or a part of their life cycle in the water. These swamps are particularly important for the production of red swamp crawfish.

MARSHES

A.5.63. General. The lower reaches of the Atchafalaya Basin consist of a complex of marshes bordering the Gulf of Mexico. Salinity and elevation are the major factors influencing the types of vegetation here. The marshes can be generally classified as fresh, brackish, or saline. For the purposes of this study, Chabreck's intermediate marsh (Chabreck, 1972) has been classed as fresh. These areas are capable of producing, harboring, and nourishing an exceptional array of vertebrate and invertebrate fauna.

A.5.64. An important factor that influences the productivity of these marshes is their proximity to the Lower Atchafalaya River and the Wax Lake Outlet. The marshes that are overflowed regularly by these two outlets to the basin receive a steady supply of sediment and nutrients, and are thus highly productive. The marshes that receive river water regularly have the lowest land loss rate coastwide.

A.5.65. Marsh Acreage. In 1968, Chabreck mapped and measured the marshes of Louisiana by salinity and hydrologic unit (Chabreck, 1972). He repeated the study in 1978 but only published a map. Since the same base map was used for both studies, one can calculate the change in habitat types from 1968 to 1978 by comparing the maps, but it is impossible to determine actual loss of marsh. Adams et al. (1978) studied long term marsh losses over an 11- to 23-year period. They studied loss at several specific sites in the project area. Adams and Bauman have ongoing studies that compare pre- and post-flood marsh conditions within the project area. Wicker (1980) has just completed a study for the USFWS that delineates marsh loss from 1955 to 1978 by US Geodetic Survey quadrangle maps. These three studies investigated different size areas and utilized different methods and, understandably, each study came up with varying loss rates for the same general area. These loss rates will be discussed further as each vegetative type is described. To calculate 1980 marsh acreage, the differences by habitat types and hydrologic unit were calculated from Chabreck's 1968 and 1978 maps. The appropriate loss rates were applied to the 1978 acreage.

FRESH MARSHES

A.5.66. General. Fresh marshes are the most common type in the project area due to the influence of the freshwater of the Atchafalaya River. As indicated on Plates A-13 and A-14, these fresh marshes lie immediately south of the Bayou Teche and Bayou Black ridges. They extend southward to the shore of Atchafalaya Bay and approximately to the north end of Four League Bay. In 1980, there were approximately 323,000 acres in the project area. Between 1968 and 1978, marshes in parts of this area showed a gain in acreage while elsewhere the acreage remained the same. In areas gaining acreage, brackish marsh converted to fresh marsh. Water levels do not fluctuate greatly in fresh marsh and the decaying plant material accumulates as peat. Some of the fresh marshes in the area away from the river consist of a floating peat layer supporting a stand of marsh vegetation.

A.5.67. Loss Rates. Fresh marshes adjacent to the Lower Atchafalaya River and Wax Lake Outlet generally show a gain in marsh acreage. Wicker et al. (1980) shows a loss rate from 0.14 to 0.25 percent per year while Adams and Bauman (1980) and Adams et al. (1978) indicate a gain. The riverborne sediments prevent erosion and build new marsh. These marshes have a firm foundation and are interlaced with a network of small bayous. On the other hand, fresh marshes in Terrebonne Parish away from the riverflow show evidence of marsh loss, with loss rates increasing with distance from the Atchafalaya River. The loss rate indicated by Wicker et al. (1980) varies from 0.73 to 0.97 percent per year.

A.5.68. Vegetation and Salinity. Fresh marshes have the greatest vegetation species diversity of any marsh type. The most abundant plant is maidencane. Bulltongue, spikerush, pennywort, deer pea, and cattail are all common. Salinities in fresh marshes range from 0.06 to 6.7 ppt with a mean of 1.5 ppt.

A.5.69. Mammals. Fresh marshes provide prime habitat for the nutria. The mean harvest per 1,000 acres is 400 (Palmisano, 1973). Other furbearers, such as muskrat, mink, raccoon, and otter, are also present in trappable numbers (Table A-5-8). White-tailed deer are present with an average carrying-capacity of one deer per 300 acres. Fresh marshes provide habitat for large numbers of swamp rabbits. Various other species, such as opossums, marsh rice rats, and hispid cotton rats, also utilize fresh marshes.

A.5.70. Birds. The abundant food and shallow waters of the fresh marshes attract large numbers of wintering waterfowl, especially puddle ducks. Mallards, green-winged teal, blue-winged teal, pintails, American wigeons, gadwalls, and shovelers are common during the winter, as are snow geese and king rails. The mottled duck is a resident in fresh marshes. Wading birds, such as great blue herons, Louisiana herons, great and snowy egrets, and white-faced and white

TABLE A-5-8

FUR CATCH BY MARSH TYPE

	AVERAGE CATCH PER ACRE [1]		
	Fresh[2]	Brackish	Saline
Muskrat	0.900	0.084	0.017[3]
Nutria	0.400	0.900	Insignificant
Mink	0.002	0.001	Insignificant
Otter	Insignificant	Insignificant	Insignificant
Raccoon	0.009[4]	0.008	Insignificant

[1] From Palmisano (1973).
[2] Represents mean of fresh and intermediate marsh average harvest/acre.
[3] Calculated as 25% of brackish marsh harvest/acre.
[4] Represents one-half of combined maximum production for fresh and intermediate marsh.

ibises, are present. Sea birds, such as common terns, ring-billed gulls, and laughing gulls, use the fresh marshes and shore birds, such as black-necked stilts and killdeer, are common. Birds of prey, such as marsh hawks and red-shouldered hawks, hunt in the marsh. Red-winged blackbirds, common grackles, and seaside sparrows are also common.

A.5.71. Reptiles and Amphibians. Keiser (1976) reports a total of 10 frogs, 3 salamanders, 2 lizards, 14 snakes, 8 turtles, and the alligator as being expected to occur in the fresh marshes of the study area. The American alligator is common and present in huntable populations. The potential annual harvest is nearly 10 per 1,000 acres (Table A-5-9).

A.5.72. Fishes. The regularly flooded fresh marshes provide habitat for numerous small fish, such as mosquitofish, silversides, sailfin mollies, least killifish, and sheepshead minnows. Larger fish, such as sunfish, gar, and menhaden, live in the deeper waters of the bayous and occasionally venture into the flooded marsh when the water is deep

TABLE A-5-9
POTENTIAL ALLIGATOR HARVEST BY MARSH TYPE[1/]

Marsh Type	Hides Per Acre
Fresh	0.010
Brackish	0.006
Saline	Insignificant

[1/] From Joanen (personal communication), Louisiana Department of Wildlife and Fisheries.

enough. Additional information concerning marsh fish can be found in Bryan et al. (1976) and Stone (1980).

A.5.73. Invertebrates. Insects play a vital role in fresh marshes. Most are grazers but others, such as dragonflies, are carnivorous. Fire ants are common. Since the marsh is regularly flooded, many aquatic invertebrates, such as worms, snails, nematodes, and copepods, exist either on flooded marsh grasses or in saturated marsh soil. Marsh invertebrates are discussed in more detail by Gosselink et al. (1979).

A.5.74. Commercial and Sport Value of Fresh Marsh. The fresh marsh provides numerous user-days of hunting in the project area. Based on data in US Fish and Wildlife Service (1980), a sport hunting potential of 0.826 user-days per acre exists (Table A-5-10). The number of furs harvested per acre is shown in Table A-5-8. Fresh marshes have an alligator harvest potential of 0.010 per acre (Joanen, personal communication).

BRACKISH MARSHES

A.5.75. General. Brackish marshes form a band gulfward of the fresh marshes in Terrebonne Parish. As can be seen from Plate A-14, the band is narrow near Atchafalaya Bay and widens as the river influence wanes. In 1980, there were approximately 89,000 acres of brackish marsh in the project area (Table A-5-6). Between 1968 and 1978, the total acreage of brackish marsh in the area decreased. In 1968, the area west of Wax Lake Outlet had 11,000 acres of brackish marsh; but by 1978, this had converted to fresh marsh due to the river influence.

A.5.76. Loss Rates. All studies indicate a progressively increasing loss rate in brackish marsh going eastward, away from the influence of

TABLE A-5-10

SPORT HUNTING POTENTIAL AND VALUE
BY MARSH TYPE

Marsh Type	Hunting Type		Potential Effort/ Acre (User-days)
Fresh/intermediate[1/]			
	Deer		0.017 [2/]
	Rabbit		0.104 [2/]
	Raccoon		0.005 [2/]
	Waterfowl		0.480 [3/]
	Rail and Snipe		0.220 [4/]
		TOTAL	0.826
Brackish			
	Deer		Insignificant
	Rabbit		0.069 [2/]
	Raccoon		0.004 [2/]
	Waterfowl		0.380 [5/]
	Rail and Snipe		0.190 [4/]
		TOTAL	0.643
Saline			
	Deer		Insignificant
	Rabbit		0.021 [2/]
	Raccoon		0.003 [2/]
	Waterfowl		0.020 [4/]
	Rail and Snipe		0.250 [4/]
		TOTAL	0.294

[1/] Assuming 1/3 area intermediate, 2/3 fresh marsh.
[2/] From data furnished by USFWS.
[3/] Based partially on records for public waterfowl hunting on Lacassine National Wildlife Refuge, 1978-79 hunting season.
[4/] Based on US Army Corps of Engineers (1974).
[5/] Based on records for public waterfowl hunting on Sabine National Wildlife Refuge, 1978-79 hunting season.

the nutrients and sediments of the Atchafalaya River. The rate near Four League Bay is 0.42 percent per year while near Lake Mechant the rate is 1.51 percent per year.

A.5.77. Vegetation and Salinity. Brackish marshes are intermediate in vegetative diversity between fresh and saline. The most abundant plant present is wiregrass while three-cornered grass, saltgrass, deer pea, and soft rush are common. Salinities can range from extremes of zero to 28 ppt with a mean salinity of 8 ppt and a general range of 6 to 18 ppt.

A.5.78. Mammals. Muskrats prefer brackish marshes. The average catch is 84 per 1,000 acres (Palmisano, 1973). Other furbearers, such as nutria, mink, otter, and raccoon, can also be found. Swamp rabbits, marsh rice rats, and opossums are present. (Gosselink et al., 1979).

A.5.79. Birds. Both puddle ducks and diving ducks are attracted to brackish marshes in moderate numbers. Wading birds are numerous at all times but become exceptionally abundant during spring and summer. Sea birds, such as ring-billed gulls, laughing gulls, and Forster's terns, are common. Shore birds, such as plovers and sandpipers, are also present. Additionally, swallows, red-winged blackbirds, wrens, and savannah sparrows are common inhabitants of the brackish marsh (Gosselink et. al., 1979).

A.5.80. Reptiles and Amphibians. Brackish marshes do not generally provide habitat for large numbers of amphibians; however, five species of frogs and toads have been reported. Reptiles are more common, with five species of turtles and 10 species of snakes present (Gosselink et al., 1979).

A.5.81. Fishes. Brackish marshes provide valuable nursery habitat for several species of fish and shellfish, especially menhaden and white shrimp. The decaying brackish marsh grass plays a vital role in the food web.

A.5.82. Invertebrates. Nematodes and polychaete worms are abundant, although benthic species richness is low in brackish marshes. Ostracods and amphipods are also common. Water beetles, biting midges, and dragonflies are common predaceous insects (Gosselink et al., 1979).

A.5.83. Commercial and Sport Value of Brackish Marsh. Sport hunting is less in brackish than in fresh marsh. Potential user-days per acre are shown in Table A-5-10. From Table A-5-8, it can be seen that fur catch is lower in brackish than fresh marshes. Potential alligator harvest in brackish marsh is 0.006 per acre (Joanen, personal communication). The detritus produced by the brackish marsh plants is part of a food web that supports most sport and commercial fish and shellfish.

SALINE MARSHES

A.5.84. General. Saline marsh is present only in the southern part of Terrebonne Parish where there are 108,000 acres. The fringe of saline marsh is very narrow near Atchafalaya Bay and widens to several miles farther east. Between 1968 and 1978, the actual amount of saline marsh in Terrebonne Parish decreased by 11,600 acres. Most of these acres have become brackish marsh.

A.5.85. Loss Rates. Wicker et al. (1980) indicates a much larger loss rate adjacent to Terrebonne Bay (1.26 percent per year) than in saline marsh near Four League Bay (0.47 percent per year).

A.5.86. Vegetation and Salinities. Plant species diversity is low in saline marshes. Oystergrass is the dominant species with saltgrass, wiregrass, and black rush also present. Salinities can range from 1 to 35 ppt with a mean of 18.

A.5.87. Mammals. There are few mammals present in saline marshes. Some muskrats live there as well as the raccoon, opossum, swamp rabbit, and marsh rice rat.

A.5.88. Birds. Wading birds utilize saline marshes in large numbers. More gulls and terns are present in these marshes than in other types. Other shore birds are also common because the tidal fluctuation produces extensive mudflats for feeding. In general, more shore bird species utilize saline marshes than any other marsh type.

A.5.89. Reptiles and Amphibians. Saline marshes provide very poor habitat for these animals. Generally, no amphibians are present and the only two species of reptiles likely to be encountered are the salt marsh water snake and the diamondback terrapin.

A.5.90. Fishes. These marshes provide valuable nursery and feeding habitat for numerous estuarine dependent fish and shellfish. During regular tidal inundation, vast acreage of salt marsh becomes available for young fish, shellfish, and their predators. Spotted seatrout, red drum, shrimp, and blue crabs all rely on these marshes for nursery areas. The detritus produced from decaying marsh grasses is a vital part of the food web.

A.5.91. Invertebrates. Leafhoppers, grasshoppers, flies, and mosquitoes are some of the terrestrial insects present. Spiders are important carnivores in saline marshes. The marsh periwinkle is a common detritivore. Copepods, amphipods, polychaete worms, and nematodes are present in the sediment. Large numbers of fiddler crabs burrow in the edges of the salt marsh.

A.5.92. Commercial and Sport Value of Saline Marsh. Due to the lack of mammals, only muskrats are trapped and those in very small

numbers. The alligator harvest is negligible. Hunting potential is far less than in other marshes. Only rail and snipe hunting provide a significant number of user-days per acre.

OPEN LAND

A.5.93. General. This land-use category includes: levees, dredged material disposal areas, croplands, and pastures. A total of 528,200 acres of such land is present in the project area; 16,400 acres in the Lower Atchafalaya Basin Floodway; 80,800 acres, in the backwater area northeast of Morgan City; and the remainder, in the area north of the latitude of Krotz Springs.

LEVEES

A.5.94. Flora. Several thousand acres of manmade levees now exist in the project area. These levees are generally maintained free of woody vegetation by frequent mowing. They are vegetated primarily with herbaceous species, including Vasey, smut, Dallis, Johnson, Bermuda, panic grasses and Santa Maria, cyperus, and common ragweed.

A.5.95. Fauna. The regularly maintained levees probably do not provide exclusive habitat for any wildlife species, but do often provide grazing range for domestic cattle and feeding areas for cattle egrets. These areas provide support habitat for white-tailed deer, rabbits, and a variety of nongame species and also provide nesting habitat for large numbers of turtles. During floodflows, these elevated areas serve as a refuge for animals forced out of their habitat by rising waters.

DREDGED MATERIAL DISPOSAL AREAS

A.5.96. Flora. Several thousand acres of terrestrial disposal sites now exist in the project area. The age of the site, degree of flooding, and proximity to other vegetative types generally dictate species coverage and composition. Recently used sites may follow a trend of succession from annual herbs to perennial and biannual herbs to shrubs, or may vegetate immediately with willows. Older sites in nonmarsh areas are often vegetated with trees characteristic of a dry bottomland hardwood type. In the marshes, banks of dredged material occur along canals and navigation channels. Depending on the age of the site, vegetative associations range from primary stages of succession to communities composed of vegetation common to the chenieres of the coastal plains. Generally, an overstory canopy

exists only when disposal sites occur near freshwater marshes. In a saline environment, succession terminates at the shrub stage. Those sites capable of supporting trees will succeed to black and sandbar willows and Chinese tallow trees following the shrub stage and later to hackberry and live oak. In general, the understory will vary with the proximity of the site to fresh or saline waters. In freshwater areas, black and sandbar willow, yankeeweed, aster, and goldenrod are early colonists. Later, eastern baccharis, elderberry, and deciduous holly become established. Understory species on disposal banks near saline waters include marsh elder, eastern baccharis, sea-purslane, hogcane, feather fingergrass, wiregrass, and saltgrass.

A.5.97. Fauna. Basically, species inhabiting disposal areas would be characteristic of the species occurring in a vegetative community similar to that of the disposal site. Therefore, during the early stages of succession, wildlife species would be representative of those common to the early successional association, and as succession progressed, the species composition would change gradually to one typical of a bottomland hardwood forest. Shrub areas in the marshes support swamp rabbits, raccoons, and various species of snakes, rats, and mice. Embankments of dredged material, throughout the project area, serve as a refuge for animals during high water. The embankments of shrubs and trees in the marsh provide valuable resting and feed habitat for migrating song birds. Animal population densities are generally related to the size of the disposal areas, and some species might not occur unless sufficient supportive habitat contiguous to this area exists.

CLEARED LANDS

A.5.98. Flora. Several hundred thousand acres of the project area have been cleared for agricultural purposes, including both row crops and pasturelands. Row crops of the area include soybeans, corn, milo, cotton, rice, and sugarcane. Pasturelands are vegetated with Dallis grass, bahia grass, Bermuda grass, bluegrass, winter grass, and winter grains, such as wheat. Various other herbaceous species, including Johnson grass and smutgrass, occur along fence rows, field borders, and ditch banks.

A.5.99. Fauna. Numerous small mammals and birds depend on agricultural areas for food and cover, especially the cottontail rabbit, bobwhite, woodcock, mourning dove, and various songbirds. Big game animals like the white-tailed deer and the wild turkey use these agricultural areas, especially soybean fields and improved pastures, as a supplemental food source or as brood-rearing habitat.

ATCHAFALAYA BAY DELTA

A.5.100. This is a unique area that includes a vegetative mixture of early successional bottomland hardwood forests, disposal areas, and marshes. The 10,100-acre emerging delta is one of the major deltas on the gulf coast and one of the few in the United States. A heavily utilized navigation channel, running from Morgan City to the Gulf of Mexico, passes through the delta. Due to construction and maintenance of this channel, a line of islands, parallel to the channel, has been built through the bay and to the west. The northern island is about 2.5 miles long, 1 mile wide, and has a crest elevation of 10 feet NGVD. Southward, the islands are smaller and lower. Portions of the islands above 2 feet NGVD are generally covered with black or sandbar willows and various grasses and herbs. Land below 2 feet NGVD is usually vegetated with fresh marsh species, such as delta duck potato, bulltongue, and Walter's millet. West of these disposal areas, natural marshes occur. Disposal of dredged material from maintenance dredging in Atchafalaya Bay is confined to the west side of the channel. All major distributaries are left open so that natural marsh accretion is allowed. In the maintenance program, attempts are made to preserve marsh. The disposal pipe is placed just west of the ridge on the higher islands and much of the dredged material is deposited on the western slope. However, some marsh is lost with each maintenance dredging. In the southern portion of the bay, small disposal islands are built with their centers no more than 3,000 feet apart and their maximum elevation limited to 2.25 feet NGVD. The delta in the eastern portion of the bay is relatively undisturbed by man. Some shell dredging and oil field pipeline construction have occurred. This area is characterized by V-shaped islands with willows forming the "V" and fresh marsh species lying between the arms. In December 1975, an uncontrolled aerial photo mosaic of the area, indicated approximately 1,300 acres of vegetated marsh and 7,000 acres of mudflats. Most of the emergent land was created during the 1973-75 high water period. Since then, very little aerial delta has appeared. Apparently, subsidence and erosion are occurring at a rate that keeps pace with land emergence. Delta growth is linked to greater than normal Atchafalaya River floodflows. This delta, besides being valuable habitat for fish and wildlife, is a natural laboratory in which several groups of scientists are studying the geologic and biologic processes that occur during delta formation. The entire area is owned by the state and is operated as a wildlife management area by the Department of Wildlife and Fisheries. The marshes, mudflats, and shallow bay make it a superb duck hunting area.

CARRYING CAPACITY, HABITAT EVALUATION SYSTEM (HES), AND HABITAT EVALUATION PROCEDURES (HEP)

A.5.101. There are several methods of comparing the value of various habitat types for fish and wildlife. The most simple is carrying-

capacity, which is a measure of the number of animals of various species that can be sustained by an acre of habitat. The USFWS is developing a more complex system called the HEP. These procedures attempt to evaluate habitat in terms of its inherent value to a group of species (usually 10), which characteristically inhabit a given type of habitat. In the evaluation procedure, done for this project in 1977, the value of the habitat for individual species was rated at randomly chosen sites, utilizing habitat parameters thought to be of value as indicators of the quality of the habitat for the species in question. These values for each species, for each site, were then compiled and used to calculate a Habitat Unit Value, which was taken to be a measure of the quality of the habitat for fish and wildlife. In the HES, developed by the US Army Corps of Engineers, Lower Mississippi Valley Division, randomly chosen sites within a habitat type are evaluated and various physical, chemical, or biotic parameters believed to be correlated with the carrying-capacity of the habitat for all fish and wildlife are measured. These measurements are then used to calculate a Habitat Unit Value that is believed to be indicative of the quality of the habitat. Table A-5-11 summarizes the results of studies designed to determine the value of the various habitat types within the project area as expressed by the HES and the HEP.

VEGETATIVE TRENDS

A.5.102. Available aerial photography covering four test strips through the Atchafalaya River Basin in 1930, 1952, and 1973 was used to conduct a vegetation trend analysis (US Department of Interior, 1975). The following discussion presents the findings of the analysis. Within the entire basin from 1930 to 1973, sedimentation has been responsible for substantial decreases in surface water, decreases in the acreage of cypress-tupelo forest, and increases in the acreage of mixed hardwood forest. The portion of the two floodways north of Highway 190 is nearing an oak type climax forest, with vegetative succession more or less stabilized. Clearing of the vast mixed hardwood forests for agriculture is now the evident pattern of land use in this region of the basin. The portion of the basin just north of I-10 shows a large increase in hardwood forests since 1930, and willows are gradually invading the swamps. At a latitude 20 miles north of Morgan City, changes have occurred at an increasing rate. Sedimentation is causing the rapid invasion of cypress-tupelo swamps by willows. At a latitude of 5 miles north of Morgan City, willows are not invading swamps but are pioneering the newly created sandbars in Grand and Sixmile Lakes.

A.5.103. US Army Corps of Engineers studies indicate that the southeastern portion of the basin is a comparatively stable area. The extensive cypress-tupelo swamps on the eastern side of the main channel remain much as they were in 1930.

TABLE A-5-11

EXISTING HABITAT UNIT VALUES

Habitat Type	HES		HEP	
	Aquatic	Terrestrial	Aquatic	Terrestrial
Mid-to-Late-successional bottomland hardwood forest	27.0	57.5	58.0	64.3
Cypress-tupelo swamp	55.0	67.0	68.0	38.9
Early successional bottomland hardwood forest	27.0	43.2	Not evaluated	34.9
Cropland/pasture/levee		25.6	45.0	16.0
Open gulf			85.0	Not evaluated
Saline pond or lake			83.5	32.6
Saline bayou			82.5	Not evaluated
Saline bay			90.5	27.5
Saline marsh			81.7	34.8
Brackish bayou			63.5	Not evaluated
Brackish bay			73.0	33.4
Brackish marsh			66.1	55.4
Brackish lake			60.5	39.1
Fresh marsh bayou			75.5	Not evaluated
Fresh marsh lake			72.7	54.6
Fresh marsh			81.7	34.8
Active delta			84.5	57.7
Riverine or			52.2[1/] 49.5[2/] 53.8[3/] 46.0[4/]	20.8
Fresh bayou	80.0		70.4[1/] 52.0[2/] 59.0[3/] 29.0[4/]	56.1
Headwater lake	93.5		68.3	48.0
Backwater lake	90.0		60.0[1/] 53.0[2/] 58.4[3/] 53.7[4/]	56.1
Cropland lake	76.0		47.5[1/] 47.5[2/] 45.5[3/] 45.5[4/]	34.8

[1/] Lower Basin.
[2/] Upper Basin.
[3/] Lower Red River Backwater.
[4/] Upper Red River Backwater.

WEST ATCHAFALAYA AND MORGANZA FLOODWAYS

A.5.104. The separate management of these two floodways has had differing effects on the vegetative trends; however, the general pattern has been one of increased agricultural development rather than a natural succession of vegetation. The predominant forest type since 1930 has been bottomland hardwoods; this community has represented a stable, self-perpetuating natural vegetative type in this area. Between 1930 and 1973, most of the swamp had succeeded to bottomland hardwoods. Generally, the trend in the few remaining swamp areas is a gradual succession toward a bottomland hardwood forest. The predominant trend in these floodways is clearing of bottomland hardwoods for agricultural purposes.

LOWER ATCHAFALAYA BASIN FLOODWAY

A.5.105. Along the latitude of Henderson and Ramah (below I-10), sedimentation has played a significant role in vegetative succession patterns. The overall trend has been a large decrease in the extent of the mature, sparse cypress-tupelo swamps and an increase in the acreage of willows, bottomland hardwood forests, and human development. In 1930, this area was dominated almost equally by cypress and willow. Sparse cypress-tupelo acreage had decreased by more than 80 percent. Finally, in 1973 the trend of vegetative succession had placed bottomland hardwoods and cypress mixed with willow as the dominant forest types in this region.

A.5.106. Along the latitude of New Iberia and Pierre Part (about 20 miles north of Morgan City), sedimentation has also played a significant role in vegetative succession patterns. Of prime significance in this area is the increasing rate at which changes are occurring. In 1930, almost half of the area was cypress-tupelo forests. By 1952, this forest type had decreased only slightly. The change from 1952 to 1973, however, was dramatic; the vast cypress-tupelo forests that were present between 1930 and 1952 had been completely transformed into a cypress-willow-tupelo type. Some of the areas that experienced this succession include the area to the east of Little Bayou Pigeon, Hog Island, the area between Grand Lake and Little Bayou Pigeon, and Turkey Island.

A.5.107. Along the latitude of Franklin (about 5 miles north of Morgan City), marked contrast exists in the patterns of vegetative succession. The forest cover type of this area in 1930 was predominantly the cypress-tupelo association, although intensive logging activities prior to that time had substantially decreased the number of mature cypress in the area. There were no stands of willow in this area in 1930. In 1952, the forest cover types were much the same as in 1930. Despite the seeming stability in forest cover types,

however, a significant change had occurred. Newly accreted lands had emerged in the vicinity of Grand and Sixmile Lakes and these became the sites of extensive pure stands of young willow trees. The 1973 forest associations were essentially the same as in 1952. The dominant cover type remained cypress-tupelo. The trend of emergence of new stands of willows in the Grand Lake and Sixmile Lake region, first evident in 1952, continued at an increasing rate through 1973. As large areas of newly accreted land appeared, extensive stands of pure willows became established and dominated the vegetative type of the western half of this area. This newly accreted land has considerably decreased the surface area of water in the lower part of the basin.

Aquatic Resources

INTRODUCTION

A.5.108. The waters of the project area have been classified into 14 habitat types. Table A-5-7 lists these types and the acreages of each in 1980. For purposes of this study, the Lower Atchafalaya Basin Floodway has been separated into four aquatic habitat types: riverine, distributary or open-ended canals; freshwater bayou or slow-flowing canals; headwater lake; and backwater lake. This division is somewhat artificial because at high water, some bayous act as distributaries while at low water they are slow-flowing. Certain lakes, during high water, may have a headwater regime; while at other times flow enters them via backwater. Additionally, during much of the year cypress-tupelo swamps serve as aquatic habitat. In spite of the incongruities, the classification system is generally valid and provides a basis for comparison of habitats.

A.5.109. Prior to discussing the specific habitats, it may be appropriate to point out that the high productivity of the aquatic ecosystem of the Lower Atchafalaya Basin Floodway is directly attributable to the annual cycle of flooding and dewatering which normally occurs and to relate the typical sequence of events which are prevalent. The cycle starts with rising waters in the late winter and early spring. The bayous and lakes swell, overflow their banks, and spill into adjacent swamps and hardwood forests. As waters cover the forest floor, they flood the decomposing particles of plant material. Bacteria and fungi attach themselves to this detritus and break it down further. The detritus and its halo of organisms are eaten by detritovores, such as bullhead minnow (Levine, 1977), crawfish (Thomas, 1975), and numerous amphipods, ostracods, and cladocerans (Pennak, 1978). It is actually the halo of bacteria and fungi that is digested and the plant material is expelled as waste to be colonized by a new halo. The number of detritivores, especially,

zooplankton and crawfish, peaks in the spring when the amount of detritus is greatest. Breeding seasons of fish and many aquatic organisms coincide with the high water period. The expanded amount of habitat and vast amount of food available provide ideal conditions for birth, growth, and survival of young. The moving waters in the spring provide ample oxygen for developing organisms and prevent excessive deposition of sediment. During the summer, the waters fall, and fish are forced into permanent water bodies. Detritus is no longer flushed from the swamps and forests, but as the waters clear in the summer, high populations of phytoplankton occur. These serve as a food source and alleviate dissolved oxygen shortages that frequently occur in the summer. The newly dry forest and swamp floors are aerated and oxidized. This process releases nutrients which, in turn, are taken up by the vegetative ground cover that develops. In the fall the annual plants die, and the trees lose their leaves, thereby providing the source of detritus that will drive the system the following spring.

A.5.110. The following discussion describes the differences and similarities among the aquatic habitat classifications for the Lower Atchafalaya Basin Floodway. During the early 1970's, the Cooperative Fishery Unit at Louisiana State University (LSU) conducted a 3-year study of the limnology of the Atchafalaya Basin Floodway system (Bryan, et al. 1974, 1975, and 1976), which was concentrated in the Buffalo Cove area, the main river, and the Flat Lake/Duck Lake area (Figures A-5-10 and A-5-11). Unless otherwise noted, data cited for the floodway system are from these LSU reports. It is difficult to analyze the LSU data with respect to the aquatic habitat types in the floodway system that were considered in this study. In LSU's 1976 summary of physical and chemical data, only four parameters were displayed, bayous and swamps were combined, and no information was presented for backwater lakes. Therefore, to analyze seasonal trends for bayous and swamps, it was necessary to refer to LSU's 1975 report and utilize data on Little Bayou Sorrel and Buffalo Cove swamp. The LSU team did not report on true backwater lakes in the lower basin but studied one in the upper basin in late 1975. Then in 1977, LSU prepared a short report that summarized their chemical data in terms of the five aquatic habitat types considered in this study. Apparently, data utilized for this report were not included in any of their 1974, 1975, or 1976 reports. Thus, Tables A-5-12 through A-5-15 and the discussion on monthly trends for temperatures, dissolved oxygen, total phosphorus, and suspended solids are taken from data in the 1974-76 reports while discussion of other parameters and Table A-5-16 are taken from the 1977 report. In addition to the major classifications, other types of aquatic habitat encountered in the project area are addressed.

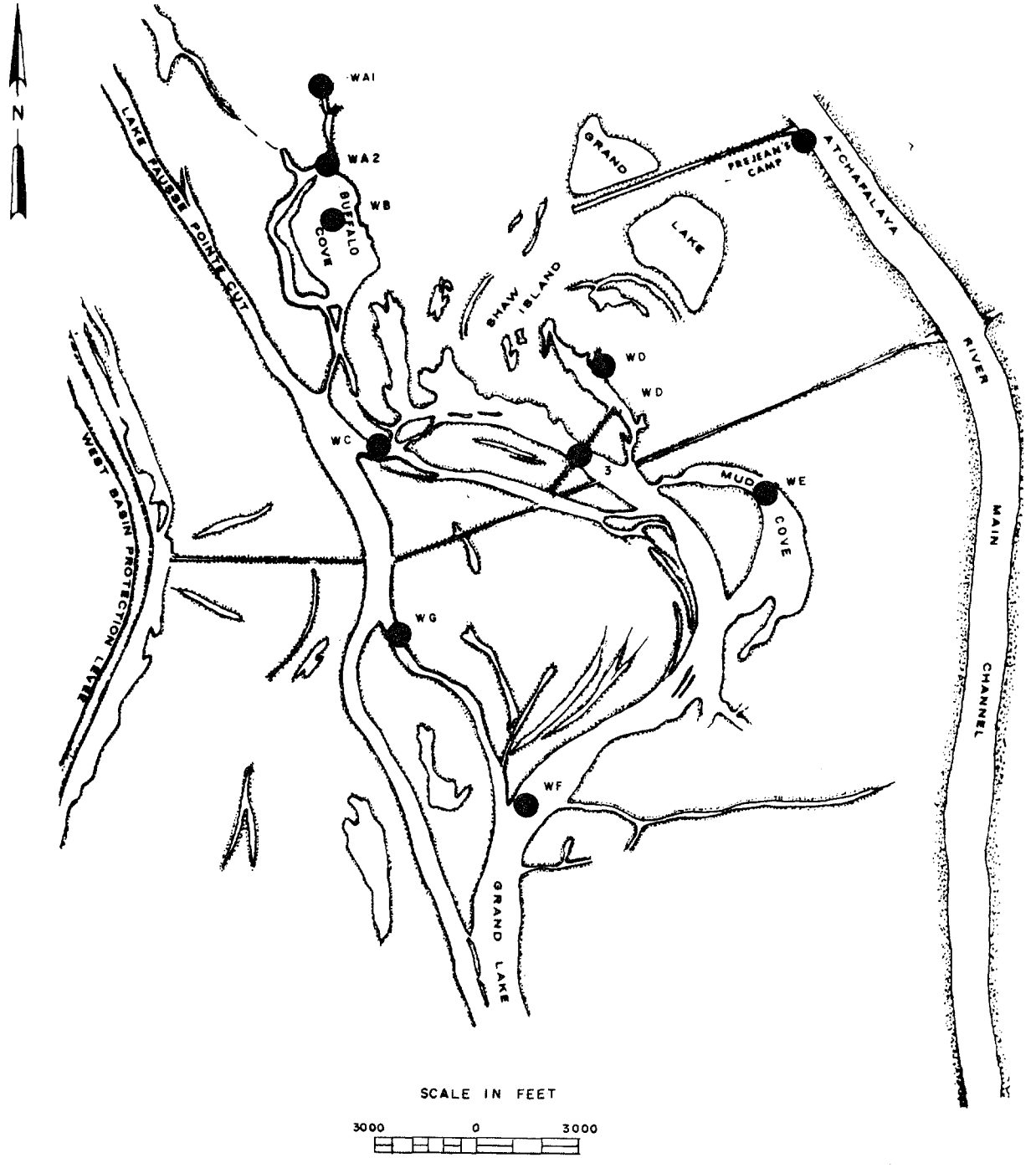


FIGURE A-5-10 LSU AQUATIC SAMPLING SITES

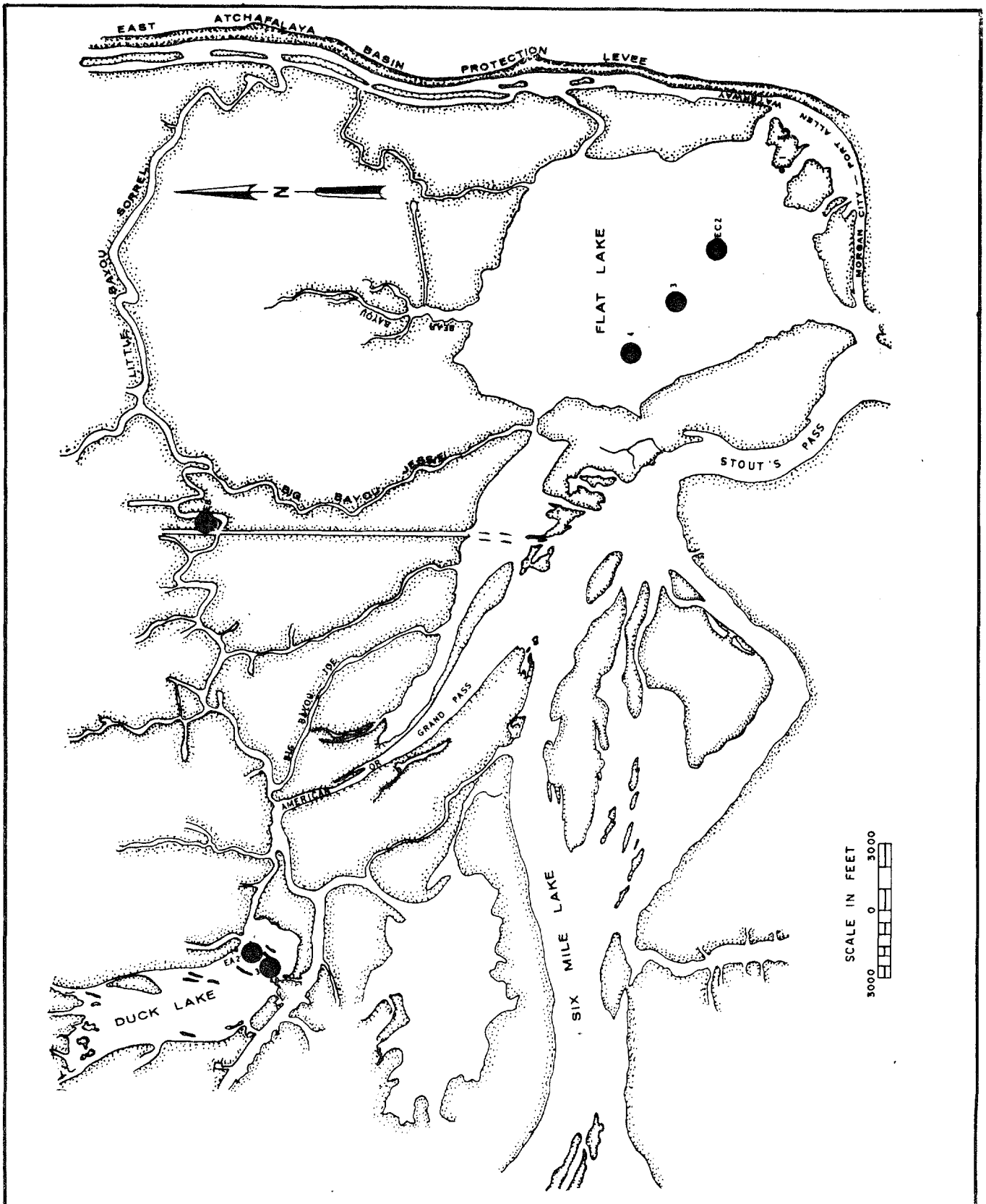


FIGURE A-5-11 LSU AQUATIC SAMPLING SITES

TABLE A-5-12

MONTHLY VARIATION IN TEMPERATURE IN °C
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	AQUATIC HABITAT TYPES			
	RIVERINE[1] MEAN (RANGE)	BAYOUS[2] MEAN (RANGE)	HEADWATER LAKES[3] MEAN (RANGE)	SWAMPS[4] MEAN (RANGE)
Sep 73	27.4 (27.0-28.0)	27.5 (27-28)	27.5 (24.5-28.5)	25.7 (24.2-27)
Oct 73	23.1 (19.4-27.5)	22.2 (20.5-23.5)	22.7 (21-30)	23.6 (20-28)
Nov 73	16.2 (12-19.3)	16.8 (13.5-19.5)	17.7 (14-20.5)	16.6 (15-19)
Dec 73	12.5 (11.5-13.0)	9.1 (3-13.5)	13.4 (11.5-14.5)	13.3 (12.5-13.5)
Jan 74	6.6 (4.5-9.0)	14.6 (14.2-15)	10.7 (6.5-15.2)	- - -
Feb 74	10.2 (9.0-12.0)	13.0 (13.0-13.9)	12.0 (11-13.5)	11.6 (11.5-12.0)
Mar 74	16.4 (15-18)	20.5 (19.8-21.2)	18 (16.5-21.8)	17.1 (16.5-18)
Apr 74	17.3 (15.8-20)	20.4 (19.8-20.5)	19.2 (18-21.5)	18.7 (18-19.1)
May 74	23.3 (21.5-25.5)	23.1 (22.5-23.5)	23.7 (22.5-25.5)	24.3 (23-25.5)
Jun 74	25.1 (24.5-26)	27.6 (27-28.5)	26.9 (25-30.5)	25.3 (23-29)
Jul 74	28.0 (25.5-29)	26.5 (25-28.2)	27.3 (25.5-29.5)	26.9 (25-28)
Aug 74	29.1 (26-32)	29.8 (28.5-32.0)	28.3 (25-34.5)	27.0 (25-29)
Sep 74	25.1 (23-26)	26 (24-27)	26.4 (24-29.5)	25.4 (23.5-29)
Oct 74	20.3 (18-22.5)	20.3 (18-23.5)	21.0 (18-24)	19.8 (17.5-22)
Nov 74	16.5 (13.5-19.1)	14.9 (13.6-16.5)	16.6 (14-19.2)	16.9 (16-18)
Dec 74	9.4 (8-11)	10.8 (10.5-11)	10.3 (9.0-11. 5)	9.8 (8.9-11)
Jan 75	9.7 (8-12.5)	11.1 (10.5-11.5)	10.4 (9.0-12.5)	- - -
Feb 75	12.4 (6.0-16.5)	16.0 (15-17)	12.9 (10.5-16)	- - -
Mar 75	13.3 (9.7-17.5)	14.0 (13.8-14.2)	13.7 (10.5-16.5)	- - -
Apr 75	14.8 (13-19)	- - -	14.6 (13-16)	- - -
May 75	23.0 (22-24)	- - -	23.3 (22.5-24)	- - -
Jun 75	26.0 (23.1-27)	- - -	26.7 (25.5-27.5)	- - -
Jul 75	28.8 (27.5-30)	- - -	28.5 (26-31)	- - -
Aug 75	26.7 (20.5-31.5)	- - -	31.5 (31-32)	- - -
Overall	20.5 (4.5-32)	19.9 (3-32)	20.6 (6.5-34.5)	19.6 (8.9-29)

1/ Mainstem at Simmesport, West Access Channel (RA) and Morgan City (RB).
2/ Little Bayou Sorrel (EB).
3/ Buffalo Cove Lake (WB), Duck Lake (EA), Flat Lake (EC), and Shaw Island Lake (WD).
4/ Buffalo Cove Swamp (WA).

TABLE A-5-13

MONTHLY VARIATION IN DISSOLVED OXYGEN (MG/L)
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	AQUATIC HABITAT TYPES			
	RIVERINE[1] MEAN (RANGE)	BAYOUS[2] MEAN (RANGE)	HEADWATER LAKES[3] MEAN (RANGE)	SWAMPS[4] MEAN (RANGE)
Sep 73	6.6 (4.9-7.9)	3.9 (3.2-4.7)	5.2 (3.2-6.6)	3.0 (2.2-3.8)
Oct 73	6.7 (5.5-8.4)	3.8 (2.5-4.8)	6.1 (4.3-15.2)	4.6 (1.7-8.2)
Nov 73	7.4 (6.3-10.4)	4.4 (4.2-4.9)	5.7 (4.0-8.2)	2.9 (1.3-5.5)
Dec 73	7.4 (6.7-9.0)	4.6 (4.3-4.9)	6.2 (4.4-9.0)	4.5 (4.1-5.4)
Jan 74	12.0 (11.9-12.0)	5.1 (5.0-5.2)	9.0 (5.7-11.3)	- - -
Feb 74	7.2 (6.8-7.4)	5.9 (5.8-6)	6.6 (5.8-7.8)	6.3 (6.1-6.9)
Mar 74	8.6 (7.6-10)	3.8 (3.4-3.9)	7.1 (4.6-9.3)	5.0 (4.8-5.3)
Apr 74	6.5 (3.6-9)	2.8 (2.5-3)	5.6 (3.6-7.8)	4.5 (4.3-4.6)
May 74	5.2 (3.3-7.5)	1.8 (1.6-2)	4.1 (2.1-6.2)	2.8 (1.6-3.7)
Jun 74	5 (3.7-6.6)	1.2 (0.8-1.5)	2.9 (1.2-4.6)	1.2 (0-2.5)
Jul 74	4.5 (3.2-6.2)	0.9 (0.7-2.0)	2.2 (0.2-3.8)	0.6 (0.1-1.2)
Aug 74	4.4 (1.2-9)	3.8 (2.3-5.6)	3.8 (1.2-10.5)	0 (0-0)
Sep 74	6.1 (0.1-8.2)	2.1 (1.1-3.0)	5.3 (0-8.6)	5.7 (5.2-6)
Oct 74	5.6 (2.0-7.2)	3.9 (1.2-6.2)	4.2 (0.1-6.9)	0.8 (0-1.4)
Nov 74	6.6 (2.9-8.7)	4.6 (1.9-6.9)	6.4 (3.6-8.1)	6.8 (5.9-7.6)
Dec 74	8.9 (6.2-10.7)	4.7 (3.4-7.2)	7.6 (5.6-9.7)	5.4 (3.9-8.1)
Jan 75	8.6 (5.7-9.6)	4.1 (3.8-4.4)	7.8 (6.4-9.4)	- - -
Feb 75	8.2 (4.2-10.5)	4.4 (3.3-5.4)	7.8 (6.7-9.3)	- - -
Mar 75	7.7 (5.6-11)	2.8 (2.7-2.9)	7.8 (6.6-10.1)	- - -
Apr 75	7.2 (6.1-8.9)	- - -	7.0 (5.5-8.1)	- - -
May 75	4.9 (2.8-6.2)	- - -	3.9 (2.1-5.6)	- - -
Jun 75	3.7 (1.8-6.7)	- - -	2.9 (0.5-4.5)	- - -
Jul 75	4.2 (1.5-7.1)	- - -	2.6 (1.5-4.5)	- - -
Aug 75	6.3 (5.1-7.6)	- - -	3.5 (2 -5)	- - -
Overall	- (0.1-12)	3.6 (0.7-7.2)	(5.7 - 15.2)	4.2 (0 - 8.2)

1/ Mainstem at Simmesport, at West Access Channel (RA), and Morgan City (RB).
2/ Little Bayou Sorrel (EB).
3/ Buffalo Cove Lake (WB), Shaw Island Lake (WD), Duck Lake (EA), Flat Lake (EC).
4/ Buffalo Cove Swamp (WA).

TABLE A-5-14

MONTHLY VARIATION IN TOTAL PHOSPHORUS (MG/L)
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	AQUATIC HABITAT TYPES			
	RIVERINE [1] MEAN (RANGE)	BAYOUS [2] MEAN (RANGE)	HEADWATER LAKES [3] MEAN (RANGE)	SWAMPS [4] MEAN (RANGE)
Sep 73	0.06 (0.05-0.06)	- - -	0.07 (0.03-0.13)	- - -
Oct 73	0.44 (0.42-0.46)	0.16	0.25 (0.15-0.38)	- - -
Nov 73	0.32 (0.31-0.33)	0.10 (0.08-0.13)	0.17 (0.10-0.31)	0.06
Dec 73	0.51 (0.46-0.60)	1.10	0.21 (0.08-0.46)	- - -
Jan 74	0.28 (0.27-0.29)	0.06	0.16 (0.14-0.19)	- - -
Feb 74	0.18 (0.14-0.21)	0.11	0.12 (0.10-0.16)	0.14
Mar 74	0.23 (0.22-0.24)	0.11	0.15 (0.14-0.18)	0.15
Apr 74	0.27 (0.27)	0.08	0.12 (0.11-0.13)	0.13
May 74	0.14 (0.04-0.30)	0.10	0.14 (0.09-0.26)	0.07 (0.05-0.13)
Jun 74	0.38 (0.37-0.39)	0.04	0.10 (0.08-0.11)	0.10
Jul 74	0.28 (0.25-0.30)	0.03	0.09 (0.04-0.12)	0.12
Aug 74	0.12 (0.12-0.13)	- - -	0.10 (0.07-0.16)	0.07
Sep 74	0.12 (0.12-0.13)	- - -	0.31 (0.12-0.79)	0.20 (0.19)
Oct 74	0.25 (0.22-0.28)	0.11 (0.09-0.13)	0.13 (0.12-0.13)	0.20 (0.08-0.32)
Nov 74	0.36 (0.20-0.51)	0.08 (0.07-0.10)	0.14 (0.06-0.22)	0.13
Dec 74	0.30 (0.28-0.31)	0.03	0.11 (0.08-0.14)	0.08 (0.08-0.08)
Overall	0.23 (0.04-0.60)	0.14 (0.03-1.10)	0.15 (0.03-0.79)	0.11 (0.05-0.32)

[1] Fausse Point Cut (WC and WG) and Bayou Chene - Alligator Bayou.
[2] Little Bayou Sorrel (EB)
[3] Buffalo Cove Lake (WB), Shaw Island Lake (WD), Duck Lake (EA), Flat Lake (EC).
[4] Buffalo Cove Swamp (WA).

TABLE A-5-15

MONTHLY VARIATION IN SUSPENDED SOLIDS (MG/L)
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	AQUATIC HABITAT TYPES			
	RIVERINE [1] MEAN (RANGE)	BAYOUS [2] MEAN (RANGE)	HEADWATER LAKES [3] MEAN (RANGE)	SWAMPS [4] MEAN (RANGE)
Sep 73	358 (336-379)	- - -	29	- - -
Oct 73	288 (282-292)	- - -	131 (26-321)	- - -
Nov 73	545 (545)	381	105 (26-242)	72
Dec 73	242 (235-248)	- - -	208 (56-701)	- - -
Jan 74	149 (78-220	37	73 (25-105)	- - -
Feb 74	142 (137-146)	25	100 (37-138)	49
Mar 74	242 (233-250)	19	45 (33-62)	42
Apr 74	162 (118-205)	19	26 (15-31)	17
May 74	298 (297-298)	11	50 (24-67)	48
Jun 74	308 (290-327)	7	33 (22-45)	0
Jul 74	100 (78-122)	76	49 (17-84)	29
Aug 74	54 (43-65)	- - -	111 (94-130)	14
Sep 74	- - -	- - -	30 (27-33)	40
Oct 74	494 (211-776)	12 (6-18)	141	0
Nov 74	498 (437-523)	84 (81-88)	79 (20-154)	145
Dec 74	- - -	- - -	110 (93-142)	44 (42 - 47)
Overall	237 (43-776)	63 (6-381)	87 (15-701)	42 (0 - 145)

[1] Fausse Point Cut (WC and WG) and Bayou Chene - Alligator Bayou.
[2] Little Bayou Sorrel (EB).
[3] Buffalo Cove Lake (WB), Shaw Island Lake (WD), Duck Lake (EA), Flat Lake (EC).
[4] Buffalo Cove Swamp (WA).

TABLE A-5-16

PHYSICAL AND CHEMICAL PARAMETERS
IN THE ATCHAFALAYA BASIN FLOODWAY
AVERAGES AND RANGES

Parameter	AQUATIC HABITAT TYPES					
	Riverine	Bayous	Headwater Lakes	Backwater Lakes	Swamps	Cropland Lakes
Color	Turbid and muddy	Turbid during floods; tea-colored or black-clear at low flows	Turbid-green or turbid-brown	Turbid brown at high water; black-clear at low water	Clear brown to black	Pea-soup green to clear green
pH	7.5 (little variation)	7.2 (6.3 - 8.4) high in spring	7.5 (little variation)	7.1 (6.2 - 8.2) high in spring	7.2 (6.2 - 8.9) high in spring	7.7 (6.5 - 9.9) low in summer
Specific conductance (umkos/cm)	310 (104 - 705) high in summer	367 (168 - 3,285) high in spring	309 (104 - 705) high in summer	289 (130 - 505) high in summer	166 (56 - 465) high in summer	336 (43 - 651) stable
Oxidation - reduction potential (volts)	+0.551 (+0.028-+0.730) high in spring	+0.482 (+0.102-+0.740) high in spring	+0.554 (+0.028-+0.730) high in spring	+0.527 (+0.102-+0.770) high in spring	0.542 (+0.125-+0.880)	0.466 (+0.179-+0.810) high in winter
Nitrate nitrogen (mg/l)	0.60 (0.00 - 3.70) high in spring	0.20 (0.00 - 0.80) high in spring	0.35 (0.00 - 1.00) high in spring	0.30 (0.00 - 0.90) high in spring	0.35 (0.00 - 0.90) slightly higher in spring	0.20 (0.00 -0.25) much higher in spring
Organic C/ Organic N	135.0 (3.5 - 900.0) much higher in summer	35.6 (2.5 - 350.0) high in summer	122.0 (3.5 - 700.0) much higher in spring	189.0 (5.4 - 550.0) much higher in spring	27.0 (10.0 -80.0)	7.5 (1.1 - 16.0) much higher in spring
Total dissolved solids (mg/l)	190 (12 -385) slightly higher in summer	256 (100 - 850) high in summer	192 (86 - 264) high in spring	204 (129 - 412) high in spring	172 (143 - 238) very high in summer	208 (136 - 286) stable

Source: LSU, 1977.

ATCHAFALAYA RIVER, MAJOR DISTRIBUTARIES, AND MAIN STREAM LAKES

A.5.111. General. The Atchafalaya River, its major distributaries (Whiskey Bay Pilot Channel, the East and West Freshwater Distribution Channels, the East and West Access Channels, the Morgan City-Port Allen Waterway and Fausse Point Cut), and main stream lakes (Grand and Sixmile) comprise 23,000 acres of the 70,900 acres of purely aquatic habitat in the Lower Atchafalaya Basin Floodway. Thus, these riverine areas make up 35 percent of the floodway and are an even larger part of the permanent aquatic habitat. In the coastal area south of US Highway 90, this habitat type comprises 8,100 acres. These large channels are characterized by turbid, muddy waters with moderate to fast currents. The banks are usually steep except on the inside of bends where point bars accumulate. Sinuosity is generally minimal on such watercourses.

A.5.112. Physical and Chemical Characteristics. Tables A-5-12 through A-5-16 compare several physical and chemical parameters in the various aquatic habitats. The mean temperature of riverine waters generally drops below 10° Centigrade (C) in the winter and rises above 25°C in the summer (Table A-5-12). Riverine temperatures range from 4.5°C to 32°C and averaged 20.5°C in the LSU study. Riverine waters exhibit the lowest mid-winter mean temperatures of any aquatic habitat types, occasionally being as much as 8°C lower. During the spring, riverine temperatures are usually lower than all other habitat types. Mean temperatures during summer are similar to those in other habitat types while the summer range of fluctuations is less. Riverine waters consistently have the highest dissolved oxygen of all habitat types; levels range from a mean high of 12 milligrams per liter (mg/l) in the winter to a low of 4.2 mg/l in the summer (Table A-5-13). Levels approach saturation in turbulent waters when temperatures are lowest and discharge is highest and are usually more than 40 percent of saturation during low water periods. Total phosphate ranged from 0.04 to 0.60 mg/l and averaged 0.23 mg/l during the LSU study (Table A-5-14). Phosphates are generally lowest in the summer and highest in the early winter. Nitrate nitrogen is much higher in riverine habitats than in any others and the organic carbon to organic nitrogen (C/N) ratio is very high in riverine areas (Table A-5-16). LSU studies indicated that river waters are the main source of phosphorus and nitrogen for the primary production which occurs in the basin. Suspended solids are consistently highest in riverine waters ranging from 43 to 776 mg/l and averaging 237 mg/l (Table A-5-15). All these facts lead to the conclusion that the biological productivity of river water is low, especially in the winter, due to low temperatures, high turbidity, low habitat diversity, and swift currents.

A.5.113. Flora. The deep, swift, turbid riverine waters generally have few rooted aquatics except along the shoreline. Occasionally, water hyacinths and duckweed are present, having been washed out of the other areas. Phytoplankton is also sparse in riverine waters due

to turbidity, depth, and velocity. It is difficult to analyze seasonality of riverine plankton even though three studies considered it. The LSU group and Dotson (1966) found high fall peaks and spring lows (Table A-5-17), while Hern et al. (1978) indicated constant numbers throughout the year. In Dotson's 1964-65 study of the Sixmile Lake area, the filamentous green algae, Ulothrix and Mugeotia, and the unicellular Asterionella and Synedra were the most abundant. Bryan's group found the centric diatoms, Melosira and Cyclotella; the green, Scenedesmus, and the blue-green, Anacystis to be most common. The euglinoid Cryptomonas, and the diatoms, Melosira and Coscinodiscus, and Asterionella were the most abundant phytoplankton genera according to Hern et al. Floodwaters from the river appear to have a major influence on basin-wide phytoplankton. During high water periods when the entire basin is inundated, all habitats are fairly similar as phytoplankton and nutrients are transported throughout. As water levels fall, distinctive groups of phytoplankton become established in various habitats (Sager, 1976).

TABLE A-5-17

AVERAGE PLANKTON PER STATION PER MONTH

Month	Numbers Per Liter	
	Phytoplankton	Zooplankton
Sep 64	2,848	6,322
Oct 64	1,845	4,951
Nov 64	4,635	4,654
Dec 64	93	1,570
Jan 65	1,369	3,059
Feb 65	1,307	6,622
Mar 65	2,003	6,124
Apr 65	2,373	5,493
May 65	966	6,115

Source: Dodson (1966).

A.5.114. Phytoplankton in the basin does not form a major component of the food web because of its scarcity; however, it does play some role, especially in the summer. Rooted and floating aquatic plants serve as food and habitat for various fishes and shellfishes, as well as for higher vertebrates, such as waterfowl, and mammals, such as the nutria.

A.5.115. Zooplankton. During Dotson's 1964-65 study, he found microzooplankton to be more common than phytoplankton. The most abundant genus was the dinoflagellate Peridinium. Other abundant genera included the rotifers Branchionus and Polyarthra. Numbers per liter were low in the winter and high in the fall and spring (Table A-5-18). Holland (in Bryan et al., 1976) also studied microzooplankton and found the riverine community to be dominated by certain species of Keratella and Branchionus. Populations were highest in spring through fall and lowest in winter. Binford (1975) found the most abundant riverine macroplankton to be cladocerans, such as Bosmina, Diaphanosoma, and Ceriodaphnia; and copepods, such as Diaptomus. The riverine group generally peaked in March and April. Some of the most common genera peaked in the river after a peak in lakes and bayous, indicating that these genera were flushed out of lakes and bayous by the high river waters. Other genera peaked first in the river and were then dispersed into other habitats. Zooplankton are a vital part of the food web because they consume phytoplankton and detritus and, in turn, are devoured by larger organisms.

TABLE A-5-18

MONTHLY VARIATION OF PHYTOPLANKTON,
ALL STATIONS COMBINED

Month	Numbers Per Liter
Mar 1974	36.2
Apr 1974	44.2
May 1974	41.7
Jun 1974	28.5
Jul 1974	34.6
Aug 1974	51.8
Sep 1974	127.9
Oct 1974	41.2
Nov 1974	39.2

Source: Bryan et al. (1975).

A.5.116. Benthos. Substrate and water velocity are the most important factors affecting benthic production. Riverine substrates are either hard clay or shifting sands. These habitats support a meager benthic fauna, especially the hard clay (Table A-5-19). Burrowing mayflies are the most abundant organism in this substrate. More organisms inhabit the sand. Groups such as tubificid worms and chironomids are common as are damselfly nymphs and Asiatic clams. The numbers of taxa are fairly constant throughout the year with a slight peak in November. The greatest number of organisms occurs in the early summer. River shrimp prefer this habitat and a commercial bait fishery exists for them. Blue crabs, mostly large males, are harvested in the summer by sport and commercial fishermen in the mainstream lakes. Crawfish are not present in large numbers in the riverine habitat although some are harvested from the mainstream lakes.

A.5.117. Fish. About 17 families containing some 45 species of sport, commercial, and forage fishes are present in the riverine habitat type. Most of the common fish species in the basin utilize these waters at some time in their lives. Certain shiners and chubs complete their life cycles in riverine areas. Blue and channel catfish spawn here and large numbers of juvenile catfish and freshwater drum utilize riverine channels as holding and feeding areas. Young-of-the-year of several species of sunfishes, crappies, and largemouthed bass are also present. Adult shad and adult and young skipjack, flathead catfish, and striped mullet are more abundant in this habitat than any other. Spotted and white bass are common and sought after by sport fishermen (Lambou, 1963). These riverine waters provide a valuable commercial fishery with the most important species being catfishes, buffalo, and freshwater drum (Bell, 1980). Catfish are taken with trotlines and hoopnets while buffalo and drum are caught with seines and hoopnets. Lesser numbers of gar, carp, bowfin, paddlefish, and striped mullet are sold for home consumption.

TABLE A-5-19

BENTHIC ORGANISMS
IN SELECTED HABITAT TYPES

Type	Number/square meter
Riverine	327
Dead end Canals	1,593
Headwater Lakes	1,840
Bayous	3,292
Swamps	3,768

A.5.118. Birds. Diving ducks, such as lesser and greater scaup, ruddy ducks, and redheads, utilize mainstream lakes during the winter. Bellrose (1976) reported that 38 percent of the Mississippi Flyway's 40,000 canvasbacks winter on or near Sixmile Lake; however, because sedimentation is decreasing the area of open water, the locus of these concentrations may be shifting to the Atchafalaya delta.

FRESH BAYOUS, CANALS, AND BORROW PITS

A.5.119. General. These waterways have a low current velocity except at high river stages and are much more sinuous than riverine channels. Bayou habitats comprise 38,000 acres of the project area. About 15,900 of these acres are in the Lower Atchafalaya Basin Floodway and 22,100 acres in the coastal area or backwater area northeast of Morgan City. Examples of typical floodway bayous are Little Bayou Sorrel, Little Bayou Pigeon, Bayou Postillion, and Alabama Bayou. Depths are usually less than 20 feet and often less than 6 feet. Shorelines are moderately steep where there is a substantial sediment load but are nearly indistinguishable from the swamp in some portions of the Upper Belle River area.

A.5.120. Physical and Chemical Characteristics. Bayou temperatures average 19.9°C and range from 3 to 32°C (Table A-5-12). Seasonal trends in bayous are similar to those in other aquatic habitats except that temperatures are higher in the spring. Dissolved oxygen generally follows the same seasonal trends as in other habitats, being highest in the winter and lowest in the summer (Table A-5-13), but bayou oxygen levels are consistently a few tenths of a mg/l lower than other habitat types. Dissolved oxygen concentrations average 3.6 mg/l and range from 0.7 to 7.2 mg/l. Oxygen percent saturation is 20 at low water and 90 during flood stages. Outflow of swamp waters or hurricane events have depressed oxygen levels sufficiently in bayous to cause fish kills. Total phosphorus averages 0.14 mg/l in bayous and ranges from 0.03 to 1.1 mg/l (Table A-5-14). Phosphorus tends to be high in the fall and low in the summer. Suspended solids are low in bayous compared to riverine habitats, averaging 63 mg/l and varying from 6 to 381 mg/l (Table A-5-15). Suspended solids are high in the winter and low in the summmer. Some bayous are very clear at low-flow periods. Dissolved solids are higher in bayous than in any other habitat types (Table A-5-16). In summary, bayous are less turbid than riverine waters, but also generally have less dissolved oxygen so fish kills are possible at certain times of the year.

A.5.121. Flora. Bayous with their slower currents often have rooted aquatics such as coontail, fanwort, and pondweeds at their edges. Duckweed, watermeal, and water hyacinth are distributed by bayous at high water. Phytoplankton in bayous are generally less diverse and numerous than in other habitat types. Average density and diversity

fluctuated drastically with little correlation to season in the study by Hern et al. (1978). This study found bayous to have low numbers and diversity in the summer. Other workers have found phytoplankton numbers and diversity to be highest in the summer. Green and blue-green algae and diatoms peak in the summer and early fall in bayou habitats, probably due to the clearness of the water at these times (Bryan et al., 1975 and Sager, 1976). The most common species are Scenedesmus, Anacystis, Melosira, and Cyclotella.

A.5.122. Zooplankton. The zooplankton of the basin appear to be divided into two recurrent groups: those that are associated with riverine waters and those associated with all other habitat types (Binford, 1975). As discussed in the previous section, some taxa, such as Bosmina and ostracods, peak first in bayous and lakes and are then swept out into riverine waters. Some other taxa are characteristic of the more lentic waters: the heavy cladocerans such as Alona and Ilyocryptus and the copepod, Eucyclops. These genera apparently need less oxygen than the riverine genera.

A.5.123. Benthos. Bayous with their detritus-rich substrates are moderately productive benthic habitats (Table A-5-19). Tubificid worms are the most abundant organisms and chironomids and clams are second in abundance. Species diversity is very high in bayous. Dead-end canals are classified with bayous but Beck (1977) found them to have lower numbers of organisms than bayous. Worms and Asiatic clams were the most common groups present. The greatest numbers of taxa occur in bayous in March and April and the greatest numbers of organisms in June. The low numbers in late summer are probably because most organisms cannot tolerate the low oxygen of that period.

A.5.124. Fish. The most common fish in the bayous include predators, such as spotted gar and bowfin; forage fish, such as gizzard shad; sport fish, such as largemouth bass, black crappie and bluegill; and commercial fish, such as carp, smallmouth buffalo, freshwater drum, and channel catfish (Sabins, 1977). Standing crop estimates vary from 1,014 pounds per acre in Little Bayou Pigeon to 837 pounds per acre in Bayou Postillion. Small fish, such as mosquitofish, pugnose minnows, and brook silversides, are also common in bayous, especially along the edges. Bayous serve as avenues for fish to move between riverine areas and lakes. During summers when water temperature becomes very high in lakes, fish will retreat to the deeper, cooler waters of the bayous during the day and then move out to forage in the lakes at night. Bayous are fairly permanent habitat and are where fish congregate as waters recede from the swamps and forests. Bayous in the backwater area northeast of Morgan City had standing crops varying from 106 pounds per acre to 307 pounds per acre in 1973 and 1979; shad, carp, and bowfin dominated the catch (US Department of Agriculture, 1979).

HEADWATER LAKES

A.5.125. General. Almost all of the 17,000 acres of headwater lakes in the project area are in the Lower Atchafalaya Basin Floodway below I-10. These lakes are generally long and fairly wide, ranging from 1 acre to several square miles in size. The distinguishing criterion for this habitat is complete flushing by flowing water during the spring months of an average water year. When the flow-through ceases, these lakes become stillwater lakes. Water depths during nonflood periods are usually less than 9 feet. Shorelines are gradually sloped and sometimes indistinct. Sediments are often fine sand, silt, and mud in mid-lake, grading to detritus near the shore. Examples of headwater lakes include Flat Lake, Duck Lake, and Grand Lake. This habitat type has a high productivity and great species diversity due to the addition of nutrients and oxygen during overbank flooding.

A.5.126. Physical and Chemical Characteristics. Headwater lakes show a moderate seasonal variation in mean temperature, varying from above 25°C in the summer to below 15°C in the winter (Table A-5-12). During the summer, lake waters occasionally heat above 34°C due to the absence of canopy and turbulence. Dissolved oxygen in headwater lakes is generally higher than in bayous or backwater lakes. It shows the same seasonal trends as in other habitats, peaking in the winter to above 6 mg/l and dropping below 3 mg/l in the summer. Mean dissolved oxygen is 5.7 mg/l and it ranges from 0 to 15.2. Exceedingly high dissolved oxygen levels occur in the early fall when suspended solids are low and photosynthesis is rapidly occurring. Suspended solids range from 15 mg/l to 701 mg/l, and average 87 (Table A-5-15). They generally peak in December and drop lowest in mid-summer. Total phosphorus is also highest in the winter and lowest in the summer. The mean for the year is 0.15 mg/l with ranges from 0.03 to 0.79 mg/l (Table A-5-14). Productivity is often high in these lakes because dissolved oxygen conditions are generally favorable, currents are slow to nonexistent during a large part of the year, and temperatures are high.

A.5.127. Flora. Headwater lakes receive turbid floodwaters which distribute floating aquatics, such as water hyacinth. As the waters recede, many of the hyacinths thus distributed begin to multiply and often completely cover some lakes during the warm months. The low suspended solids concentrations in the summer and the shallow nature of these lakes allow luxuriant growth of rooted aquatics in many areas. Alligatorweed, pondweeds, wild celery, fanwort, and naiads are common and provide habitat and food for fish and shellfish, as well as higher vertebrates, such as ducks and turtles. The water hyacinth roots also serve as an ideal substrate for many species of microscopic plants and animals which are important in the food web. During winter and spring when flooding inundates most of these lakes, the phytoplankton communities in all habitats are very similar (Sager, 1976). As water levels fall, habitats become distinguishable and

headwater lakes with their clear, nutrient-rich waters have an abundance of phytoplankton. Diatoms, such as Melosira and Cyclotella, are common but greens, such as Scenedesmus, blue-greens, such as Anabaena and Anacystis, and flagellates, such as Euglena become abundant (Sager, 1976). Hern's group also found a high diversity in phytoplankton in headwater lakes. Numbers of organisms per liter are highest in the summer (Bryan et al., 1975 and Hern et al., 1978).

A.5.128. Zooplankton. As discussed in the previous section, zooplankton populations in lakes and bayous are similar. Genera that are common in lakes include the cladocerans, Bosmina, Chydorus, and Alona and the copepod, Cyclops and ostracods. Population peaks generally occur in the winter and early spring and then the organisms are washed out of these areas into other habitat types. Some of the cladocerans peak, or have a secondary peak, in the summer during the time of high phytoplankton productivity (Binford, 1975).

A.5.129. Benthos. Lakes are only a moderately productive habitat in terms of numbers (Table A-5-19) but show the greatest species diversity in the basin (Beck, 1977). The most common organisms are snails, midges, and tubificid worms. Leeches and sponges appear to be restricted to headwater lakes. Grass shrimp are common among the rooted aquatics and are an important food item for various fish and birds. One of the most important benthic organisms in the basin is the crawfish. It is a major link that converts detritus and plant material to animal protein. The reproductive cycle of the crawfish is correlated with the hydrologic cycle. Females produce eggs in the summer and carry them until fall. Some adults then die while others burrow in the mud to escape dessication and predation. Juveniles usually overwinter in the water. As the waters rise in the late winter, adults and juveniles move out into the newly expanded habitats such as headwater lakes and swamps where they utilize the food and cover provided in these newly flooded areas. The headwater lakes provide excellent habitat for the red swamp crawfish and are some of the most productive areas during the harvest. It has been estimated that during the high water season, the basin may contain a standing crop of 1,000 pounds of crawfish per acre (Thompson, 1974). The peak harvest occurs in April and May. Areas along the protection levees are preferred habitat for white crawfish (Bryan et al., 1975). Crawfish are a principal component in the diet of numerous predatory organisms including blue catfish, yellow bullheads, and largemouth bass during high water; and bowfin and gar during low water (O'Brien, 1977). Flathead catfish, bluegill, and black crappie also eat crawfish. Additionally, crawfish are preyed on by terrestrial predators such as wading birds, reptiles, and raccoons.

A.5.130. Fish. Headwater lakes are fairly productive fish habitat. Approximately 14 families containing 41 species of fish are present in this habitat type. Among the more prominant forage fish are mosquitofish, gizzard shad, striped mullet, bullhead minnows, silverband and

golden shiners, and silversides. Other small species are also found along the shorelines of lakes. Predators, such as bowfin and various species of gar, are common. Among the commercial fish, smallmouth buffalo, freshwater drum, carp, and yellow bullheads are the most abundant. These lakes appear to have an exceedingly high population of sport fish. Black crappie, largemouth bass, bluegill, warmouth, and redear sunfish are abundant. Rotenone studies conducted in 1975 and 1977 showed Grand Lake to have a standing crop varying from 352 to 480 pounds per acre with sport fish making up from 105 to 135 pounds of the total. These sport fish spawn in headwater lakes and young bluegill and warmouth utilize these lakes as a nursery. During LSU's study in the basin, they found the most productive fish habitat, in terms of taxa, to be areas adjacent to the protection levees. This is probably because of their sampling method, since seining was easily done there. Eight species of small fish were collected along levees. Such habitat is most logically classified with headwater lakes. Mosquitofish are abundant as are numerous darters, minnows, shiners, and madtoms. Juveniles of bluegill, warmouth, and other sunfishes reach their greatest concentrations there.

A.5.131. Reptiles and Amphibians. Shallow water bodies have the greatest species diversity of reptiles and amphibians (Keiser, 1976). These turtles, snakes, and frogs are an important link between terrestrial and aquatic ecosystems since they feed on aquatic organisms and, in turn, are often preyed upon by terrestrial species. Commercial frogging was once an important activity in the basin; however, it has declined significantly in recent years (Comeaux, 1972). The capture and sale of turtles is a long established industry in the basin. The primary species taken for human consumption include common and alligator snapping turtles, red-eared turtles, cooters, and sliders. The baby turtle market was once important but has declined since a Salmonella outbreak was traced to basin turtles.

A.5.132. Birds. Diving ducks, such as lesser scaup and redheads, utilize headwater lakes during the winter.

BACKWATER LAKES

A.5.133. General. Backwater lakes are water bodies that only receive a flow-through flushing of the river during the highest floods. Water levels are influenced mostly by precipitation and by waters backing into the area from downstream due to a high volume of water in the southern portion of the basin. Of the 79,000 acres of backwater lakes in the project area, 13,800 acres lie in the Lower Atchafalaya Basin Floodway and 28,200 acres in the backwater area northeast of Morgan City. Water depths are generally less than 6 feet and shoreline profiles are gradual. Substrate consists mainly of pulpy peats.

Typical examples are Cow Island and Lost Lake. Second Lake of the Bayou Petite Prairie system in the West Atchafalaya Floodway can also be classified as a backwater lake. Other lakes such as Bayou Darby, Murphy Lake, Henderson Lake and Buffalo Cove Lake function as backwater lakes during much of the year but during periods of average flooding, they receive some flows through. Very little work has been done in these areas; therefore, the data base for comparison with other habitat types is meager. In the backwater area northeast of Morgan City, Lakes Verrett and Palourde and Grassy Lake have been classified as backwater lakes because at high river stages, water flows back into these areas.

A.5.134. Physical and Chemical Characteristics. Data for this section is taken only from the LSU 1977 report. Temperatures range from 9°C to 32°C and averaged 19.9°C. Dissolved oxygen ranges from 0 to 120 percent saturation and averages less than 50 percent saturation overall. Levels are often at only 20-30 percent saturation at low water. Suspended solids range from 18 to 701 mg/l and average 119 mg/l. Levels are slightly higher during high water. Specific conductance is fairly low in backwater lakes. In summary, backwater lakes are generally less valuable aquatic habitat than headwater lakes because the dissolved oxygen is generally less and nutrients, in general, are more scarce. Backwater lakes may be more valuable than headwater lakes in terms of sport fish production.

A.5.135. Flora. Rooted aquatics, such as coontail, fanwort, alligatorweed, and water willow are common, especially in the summer as the waters become clear. There is very little data on phytoplankton populations in backwater lakes. Hern et al., (1980) found Melosira and Skeletonema to be the most common in Henderson Lake. The greatest numbers of individuals occurred in the winter. Lantz (1974) found green algae to predominate in Henderson Lake phytoplankton while LSU (1977) reported phytoplankton to be reduced in backwater lakes with green algae and diatoms being present in similar proportions.

A.5.136. Zooplankton. As discussed previously, zooplankton populations in lakes, bayous, and swamps are all quite similar. Daphnia and ostracods dominate the zooplankton (LSU, 1977).

A.5.137. Benthos. Communities are characterized by phantom midges and tubificid worms (LSU, 1977). Red swamp crawfish, chironomids, and clams were found to be common by Lantz (1974).

A.5.138. Fish. Data on fish from these areas are sparse. In Big Alabama Bayou, bluegill, mosquitofish, and silversides are common. Largemouth bass and gizzard shad are also present (Sabins, 1977, unpublished). Lantz (1974) found Henderson Lake to have standing crops varying from 255 pounds per acre in 1967 to 504 pounds per acre in 1970. Gizzard shad dominated the catches, with largemouth

bass, bluegill, channel catfish, and black crappie being common. Lake Verrett was found to have approximately 150 pounds per acre in 1973 and 1978; bluegill, shad, and carp dominated the catch (US Department of Agriculture, 1978).

CYPRESS-TUPELO SWAMPS

A.5.139. General. Swamps function as aquatic habitat during much of the year and thus must be considered as part of the aquatic ecosystem. Water depths are usually less than 3 feet and there is no well-defined shoreline. Bottoms are usually composed of clays and peats. The Buffalo Cove swamp is an example of this habitat type. There are 176,000 acres of swamp in the Lower Atchafalaya Basin Floodway, and 275,000 acres in the backwater area northeast of Morgan City and in the coastal area. This habitat type is very similar to the backwater lakes previously described because many swamps receive most of their water via the backwater route.

A.5.140. Physical and Chemical Characteristics. Swamps have the narrowest range of temperature because they are remote from the cooling influence of the river (Table A-5-12). Temperatures average 19.6°C and range from 8.9° to 29°C with highs occurring in the summer and fall, and lows in the winter. These swamps often have the lowest dissolved oxygen levels in summer months of any habitat type (Table A-5-13). Moving water generally provides the oxygen in the basin and during much of the year swamps are essentially stagnant, hence the low oxygen. Even at high water levels, swamps often have lower oxygen levels than other habitats. Dissolved oxygen can fall precipitously as the swamp floods and the plant material from the previous year is decomposed. As this low oxygen water comes out of the swamps, it can cause fish kills in adjacent habitat types. Suspended solids in swamps are generally slightly higher than those found in bayous and lower than those in headwater lakes. Total phosphorus appears to fluctuate through the year and is in the same range as in bayous and headwater lakes (Table A-5-14). Conductivity is lower in swamps than in any other habitat type (Table A-5-16). In summary, even though swamps can have low dissolved oxygen, they are extremely valuable habitat during high river stages because of the additional space they provide.

A.5.141. Flora. Rooted aquatics are not abundant. Coontail is occasionally present. However, water hyacinths and/or duckweed often cover great expanses of swamp especially in the southern part of the floodway. As floodwaters recede in the summer, a characteristic phytoplankton assemblage differentiates in the swamp. Diatoms such as Cyclotella and Melosira; blue-greens, such as Anacystis; and flagellates such as Euglena, Glenodinium, and Chlamydomenas appear to prefer this habitat and are rare in other areas (Sager, 1976).

Seasonal trends are similar to those in other habitat types with a peak in the summer and low in the winter. Hern et al., (1978) found the number of organisms per liter to be very high in the northern end of Buffalo Cove Lake, basically a swamp.

A.5.142. Zooplankton. Swamp zooplankton populations are generally similar to those in lakes and bayous. Ubiquitous genera, such as Bosmina and Daphnia are common as are ostracods.

A.5.143. Benthos. Swamps with their rich detrital substrate are the most productive benthic habitat in the basin (Bryan et al., 1976 and Beck, 1977). Annual spring flooding and flushing of accumulated detritus from swamps is an important factor in this productivity. The number of groups of organisms and total number of organisms in swamps peak in January and February. These parameters peak in bayous and riverine habitats in February through May and in lakes in the summer. These facts appear to indicate that benthic organisms are flushed out of the swamps and into the rest of the basin by floodwaters. Benthic organisms show the highest density and a high diversity in swamps. Major groups of organisms are equally represented, which indicates a degree of habitat stability. Clams, fly larvae, and isopods are the most abundant organisms. One reason for the high diversity is the large numbers of water hyacinths. These floating plants support a large, diverse community including amphipods, isopods, mayflies, and snails. Seasonality of hyacinth-clinging organisms is dependent on water levels and oxygen. Numbers are high throughout the spring and early summer when there is ample dissolved oxygen, then populations drop abruptly in the late summer as water and oxygen levels fall and the hyacinth mat sinks. As the mats rise with floodwaters in the winter, benthic numbers increase as the hyacinths are washed out into the lakes and bayous. Then when freezing weather comes and the hyacinths die, all the benthic organisms are added to the bottom community. Hyacinths thus provide cover for large numbers of benthic organisms, as well as for numerous fish. The red swamp crawfish reaches its highest productivity in these swamps due to the large acreage available in which to hide and forage.

A.5.144. Fish. The most common forage fish in swamps include pugnose and bullhead minnows, silversides, and juvenile shad. These fish often concentrate around the edges of the hyacinth mat. Sport fish, such as bluegill, warmouth, redear and spotted sunfish, largemouth bass, and black and white crappie, spawn in swamps. Juveniles utilize the area as a nursery, and large numbers of adults are also present. Yellow bullhead and blue catfish are common.

CROPLAND LAKES

A.5.145. General. There are approximately 6,000 acres of cropland lakes in the project area. The majority of these 6,000 acres lie in

the Red River backwater area, only 27 acres are presently found in the Lower Atchafalaya Basin Floodway. These are an important habitat type for this study, because if clearing for agriculture occurs in the basin, the few remaining headwater and backwater lakes will become classified as cropland lakes when they become surrounded by soybean fields. For this study, a cropland lake is defined as a lake which is entirely surrounded by agricultural lands and receives runoff from these lands. Such lakes are moderately deep and are generally eutrophic due to the agricultural runoff. Banks are usually steep and lined with a narrow band of cypress or bottomland hardwoods. A typical cropland lake is the upper portion of the Bayou Petite Prairie system in the West Atchafalaya Floodway.

A.5.146. Physical and Chemical Characteristics. Temperatures average 23.1°C and range from 7.7° to 34°C. Dissolved oxygen averages greater than 75 percent saturation and ranges from 0 to 200 percent. Suspended solids average 31.2 mg/l, range from 1 mg/l to 78 mg/l, and are highest during low water. Cropland lakes are more alkaline than in any other habitat.

A.5.147. Flora. Aquatics are generally not common and consist mostly of alligatorweed and coontail. Standing stocks of phytoplankton are highest of all habitats sampled. Green algae were most abundant with diatoms and blue-greens a close second.

A.5.148. Zooplankton. Microzooplankton numbers are exceptionally high in these lakes; however, species diversity is lower than in other habitat types. Data on macrozooplankton are unavailable.

A.5.149. Benthos. Benthic communities are dominated by clams but worms and midges are also abundant.

A.5.150. Fish. Forage fish, such as minnows, silversides, topminnows, and darters, are present. Shad and striped mullet are abundant. The common sport fish are largemouth bass and crappie. Bluegill and other sunfish are generally too small to enter the sport fishery. The commercial fishery is dependent on carp, buffalo, bowfin, and gar. Generally, species diversity is lowest in cropland lakes.

FRESH MARSH PONDS AND LAKES

A.5.151. General. Fresh marsh ponds cover 87,600 acres in the project area and all lie south of the ridge formed by Bayous Teche and Black. These marsh ponds are water bodies defined to be less than 64,000 acres and are valuable habitat for waterfowl, wading birds, and furbearers. Wintering ducks and geese prefer fresh marsh water bodies over more saline area and congregate on these ponds in great

numbers. Dabbling ducks are most likely to be found in fresh ponds. Tidal action from both lunar and wind-driven tides regularly raises and lowers water levels in these ponds even though they are some distance from the gulf. Depths are usually less than 5 feet and they are surrounded by fresh marsh plants. Typical fresh marsh ponds include Lake Gasha, Avoca Island Lake, and Lake Salve.

A.5.152. Physical and Chemical Characteristics. Suspended solid concentrations generally are highest in the winter and spring when discharge from the Atchafalaya River is the greatest. However, some ponds in the northern fresh marsh in Terrebonne Parish are removed from direct river influence by the existing Avoca Island levee and suspended solid concentrations in these ponds are lower than in the fresh marsh ponds to the south and west. During the winter and spring, dissolved oxygen levels in most fresh marsh ponds are high because of the influence of the oxygenated river water. Values seldom fall below 5 mg/l and usually remain at 80-90 percent saturation. During the summer and fall, levels of oxygen are lower but anoxic conditions rarely occur because mixing and circulation takes place due to tides and winds. Salinities in these fresh ponds range between 0.09 and 10 ppt but are generally less than 6 ppt (Chabreck, 1972).

A.5.153. Flora. These ponds are generally fairly clear from late spring through the fall and attached aquatics, such as spike rush, pond weeds, coontail, and fanwort, often attain luxuriant growth in them. Floating aquatics, such as water hyacinth and duckweed, are also common. Green algae, such as Cladophera and Spirogyra, commonly form floating mats in such ponds. Phytoplankton similar to that present in lakes in the basin would be present with populations peaking during the low turbidity summer months. The floating and attached plants are utilized as food for waterfowl and as cover and food for numerous fish and invertebrates. Phytoplankton plays an important part in the base of the food web.

A.5.154. Zooplankton. Zooplankton are generally abundant in these nutrient-rich ponds. Cladocerans, such as Simocephalus and Daphnia, and the copepods, Cyclops, Macrocyclops, and Eurytemora, are common. During high water periods, riverine zooplankton would predominate in these ponds. These zooplankton are an important part of the food web.

A.5.155. Benthos. The benthos of fresh marsh ponds is similar to that of headwater lakes and plays a vital role in the food web. Snails, midges, tubificid worms, and amphipods predominate. River shrimp are often common in these ponds.

A.5.156. Fish. Fresh marsh ponds are highly productive for fish. Fish of both fresh and estuarine affinities utilize these water bodies. Small fish, such as mosquitofish, least killifish, rainwater killifish, sailfin molly, and sheepshead minnow, are present in the shallows and among the aquatics. Anchovies utilize the ponds as a

nursery area. Sport fish, such as bluegill, redear sunfish, and largemouth bass, are common. Catfish are often abundant as are freshwater drum.

FRESH BAYS

A.5.157. General. Fresh bays are defined as water bodies greater than 64,000 acres in extent. There are 200,000 acres of this habitat type in the project area, including Atchafalaya Bay and West Cote Blanche Bay.

A.5.158. The fresh bays are a major component of the dynamic estuarine complex that stretches from Morgan City to the gulf. Freshwater and estuarine forms utilize the area in a constantly changing interplay as they move in and out under the influence of the varying salinities and temperatures. These bays are also exceedingly valuable habitat for wintering waterfowl. Both dabbling and diving ducks frequent them. Depths are usually from 2 to 8 feet. Bay bottoms are predominantly silty clay and clayey silt (Barrett, 1975).

A.5.159. Physical and Chemical Characteristics. The chemistry of these bays is heavily influenced by the Atchafalaya River and Wax Lake Outlet for 8 months of the year. Temperatures in fresh bays drop lower than in other bays due to the cool river water and are always lower near the river mouths. Annual water temperature near the Lower Atchafalaya River averages 15°C, while in West Cote Blanche Bay it often averages 7°C warmer (Juneau, 1975). However, bay waters are warmer than waters in the floodway. Suspended solids are greatest during periods of high river discharge in the winter and spring. In the summer prevailing southerly winds often maintain moderately high suspended solid levels. The river also influences bay salinities which average 2.9 parts per thousand (ppt) and range from 0 ppt to 13 ppt. Salinities are near zero in April and May and reach their high in later summer (Juneau, 1975 and Hoese, 1976). Dissolved oxygen levels in fresh bays are relatively high and do not vary significantly on an annual basis (Juneau, 1975). This high oxygen level is due to shallowness, fetch, tide, wind action, and river influence.

A.5.160. Flora. Attached aquatics are present in fresh bays although not in the high numbers as in marsh ponds. Wild celery, pond weed, naiads, and spike rush can all be found in these bays. Floating aquatics, such as water hyacinth and duckweed, are sometimes carried into fresh bays by the river. The phytoplankton is dominated by the river community of Melosira and Cyclotella in the winter and spring and by an estuarine assemblage of Scenedeamus and Nitzschia in the summer (Bryan et al., 1976). Blue-green algae often form mats on the shallow bottoms of these bays. The aquatics are heavily utilized by ducks while the phytoplankton plays a vital role at the base of the

estuarine food web. Inland waters, such as fresh, brackish, and saline bays, have been shown to export detritus to the gulf (Gosselink and Cordes, 1979).

A.5.161. Zooplankton. The zooplankton of the fresh bays is dominated by riverine forms, such as Simocephalus and Daphnia, during winter and spring. During low water periods a more estuarine assemblage, consisting of crab zoea, grass shrimp larvae, and the common copepods, Acartea and Labidocera, is present (Juneau, 1975, and Bryan et al., 1976).

A.5.162. Benthos. The most common organisms in Atchafalaya Bay are burrowing amphipods of the generus Corophium. Chironomid worms are common in the northern portions of fresh bays. Large numbers of road clams, Rangia cuneata, are present in muddy substrates. Snails, such as the marsh periwinkle and Vioscalba, occur regularly. Juvenile white shrimp utilize these bays in large numbers in fall (Juneau, 1975). River shrimp are often abundant in fresh bays. Commercially important blue crabs and white shrimp species utilize fresh bays as nursery areas. The road clam shells are harvested in Atchafalaya Bay for use as a gravel substitute.

A.5.163. Fish. Forage fish common in fresh bays include gizzard shad, silversides, striped mullet, freshwater gobies, and most common of all, anchovies. All the species of freshwater fish present in the basin are also present in the fresh bays; largemouth bass, sunfishes, and yellow bass. Striped bass are found in the winter. During the summer, estuarine sport fish, such as red drum, black drum, southern flounder, and Atlantic croaker, utilize these fresh bays. A valuable commercial fishery exists in these fresh bays for gar, catfishes, and buffalo in the winter; and bull sharks, drum, croaker, spot, and seatrout in the summer. Fresh bays are utilized as nursery areas by such species as southern flounder, menhaden, Atlantic croaker, and spot (Bryan et al., 1976).

BRACKISH PONDS AND LAKES

A.5.164. General. There are 55,200 acres of brackish ponds in the project area. Lost Lake and Lake Mechant are characteristic. These ponds are generally less than 5 feet deep. Water levels are affected by river discharge as well as by lunar and wind driven tides.

A.5.165. Physical and Chemical Characteristics. Concentrations of suspended solids are generally quite low in these ponds. Dissolved oxygen is usually more than 5 mg/l. Salinities ranges from 6 ppt to 18 ppt with the higher salinities occurring in the summer and early fall. Temperature ranges in ponds are greater than in adjacent brackish bayous.

A.5.166. Flora. Attached aquatics, widgeon grass, spike rush, and Eurasian watermilfoil, are common in these ponds (Chabreck, 1972). Salinities are too high for floating aquatics. Green algae, such as Enteromorpha, and blue-greens, such as Oscillatoria, often form floating mats or carpets on the bottom. Diatoms often encrust any firm substrate. Phytoplankton is generally abundant and estuarine genera, such as Nitzschia, Skeletonema, and Chaetoceros, are characteristic (Simmons and Thomas, 1962).

A.5.167. Zooplankton. Characteristic estuarine zooplankton, namely the copepods, Acartia and Labidocera, crab zoea, mysids, clam larvae, ostracods, and arrowworms are present in brackish ponds during most of the year. During periods of high river discharge, freshwater genera described in previous sections are present.

A.5.168. Benthos. Brackish ponds generally have a rich and diverse benthic fauna comprised of amphipods, copepods, mud crabs, numerous species of snails and clams, and polychaete worms. Brown and white shrimp and blue crabs utilize these ponds as a nursery area with brown shrimp being common in the summer. Oysters are also common.

A.5.169. Fish. Forage fish, such as sea catfish, lady fish, Atlantic needlefish, shipjack herring, menhaden, and anchovies, are common in brackish ponds. The shallows and grass beds are inhabited by small fish, such as sailfin mollies, sheepshead minnows, and gulf killifishes. Sport fish caught in these ponds include spotted seatrout, red drum, southern flounder, Atlantic croaker, and spot. Commercial fishermen harvest many of these same species. These ponds serve as a nursery area for numerous species of sport and commercial importance, such as drum, seatrout, and flounder. However, it must be remembered that the basis of the estuarine food web is detritus, which is produced mainly in the marshes. Turner (1979) has shown that the Louisiana commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands and not to the area of estuarine waters. Thus, as marshes subside and erode to become ponds, a vital portion of the system is lost.

BRACKISH BAYOUS

A.5.170. General. There are 6,200 acres of brackish bayous in the project area. Depths in these bayous are generally less than 9 feet and often less than 5 feet. Most bayous are sinuous and have no distinct banks but grade into the adjacent brackish marsh. Tidal action, as well as river discharge affects water levels. Currents are generally sluggish.

A.5.171. Physical and Chemical Characteristics. These bayous generally have low suspended solid concentrations because many of the

solids have been deposited in fresher areas. Dissolved oxygen levels are usually greater than 5 mg/l throughout the year. Salinities are influenced by the flow of the Atchafalaya River and by the gulf and vary from 6 ppt in the winter to 18 ppt in the summer. Temperature ranges are usually less than in fresher bayous and are also less than in adjacent ponds. Thus, at times of extreme temperatures, bayous serve as a refuge for organisms to escape the heat or cold.

A.5.172. Flora. Attached aquatics, such as widgeongrass and spike rush, are present along the banks of brackish bayous. Floating aquatics are absent. Green and blue-green algae form mats on the edges of these bayous. Phytoplankton is dominated by freshwater genera for a short period during high riverflows, but most of the year estuarine phytoplankton genera, such as Nitzschia and Chaetoceros, dominate.

A.5.173. Zooplankton. Brackish bayou zooplankton is essentially similar to that previously described for brackish ponds.

A.5.174. Benthos. The muddy bottoms of brackish bayous are inhabited by the same organisms described in the previous section on marsh ponds. Bayous are used by numerous organisms, especially brown and white shrimp, as passages between bays and ponds. Barnacles attach to any hard substrate in bayous, such as pilings.

A.5.175. Fish. The same species mentioned previously in the section on brackish ponds are present in brackish bayous.

A.5.176. Mammals. The Atlantic bottle-nosed dolphin may be present in brackish bayous.

BRACKISH BAYS

A.5.177. General. Brackish bays comprise 58,900 acres in the project area. Typical brackish bays include Four League Bay and the southern portion of East Cote Blanche Bay. Water levels in these bays are affected by wind and lunar tides but rarely by river discharge. Depths range from 2 to 8 feet in general and bottoms are of silty clay or clayey silt (Barrett, 1971) and often have concentrations of detritus. Diving ducks utilize these bays.

A.5.178. Physical and Chemical Characteristics. Conditions are similar to those previously described in brackish marsh ponds. However, temperature ranges are generally less than in ponds and turbidity is often higher due to wind mixing.

A.5.179. Flora. Flora is generally similar to that in brackish ponds. Rooted aquatics are normally less numerous because depths are somewhat greater in bays.

A.5.180. Fauna. Fauna of these brackish bays is generally similar to that in the brackish ponds. Oyster leases cover most of these brackish bays and ponds in Terrebonne Parish. Since the bays are generally deeper and more closely connected to the gulf, large marine fish, e.g. sharks, are more often present in bays than in ponds. Bays also serve as a vital nursery area for many fish and shellfish of sport and commercial importance. Juvenile brown shrimp heavily utilize them in the summer. The commercial harvest attributable to all marsh water bodies in the project area was calculated by Lindall et al., (1972) and has been modified for Table A-5-20.

SALINE PONDS AND LAKES

A.5.181. General. Saline ponds make up 64,417 acres of the project area. Tides raise and lower the water level daily. Typical saline marsh ponds are Caillou Lake and Bay Junop. Bottoms are generally comprised of silty clay and depths are usually from 2 to 5 feet.

TABLE A-5-20

COMMERCIAL PRODUCTION (IN POUNDS) OF MAJOR ESTUARINE DEPENDENT COMMERCIAL FISHERIES BY HYDROLOGIC UNIT (1963-1977)

SPECIES	UNIT V 1/	UNIT VI 2/	UNIT VII 3/
Menhaden	82,810,000	28,320,000	52,630,000
Shrimp	26,540,000	2,010,000	2,790,000
Croaker	8,680,000	1,100,000	2,410,000
Blue Crab	1,820,000	286,000	160,000
Oysters	1,130,000	- -	290,000
Seatrout	397,000		168,000
484,000			
Spot	1,700,000	214,000	570,000
Red Drum	189,000	5,000	5,000

1/ Bayou Lafourche to eastern edge of Atchafalaya Bay.
2/ Atchafalaya Bay.
3/ East and West Cote Blanche Bays, Vermilion Bay to Freshwater Bayou Canal.

Source: Lindall et al. (1972), modified.

A.5.182. Physical and Chemical Characteristics. Suspended solid concentrations are generally low in saline ponds in the winter and high in the summer (Gosselink et al., 1979). Dissolved oxygen rarely falls below 5 mg/l. Salinities average greater than 18 ppt. Temperature ranges are similar to those in brackish ponds and are generally greater than in adjacent saline bayous.

A.5.183. Flora. There are essentially no attached aquatics in saline ponds. Filamentous algae, such as Enteromorpha and Anabaena, are found in such ponds. Phytoplankton play an important role with Coscinodiscus, Asterionella, and Navicula being common (Green, 1976).

A.5.184. Zooplankton. During the summer, zooplankton populations generally peak. Characteristic organisms are the copepods Acartia, Tortanus, Temora, and Labidocera; the cladocerans Evadne and Podon; arrowworms, crab zoea, comb jellies, and oyster and snail larvae. (Gillespie, 1971, and Barrett et al., 1978).

A.5.185. Benthos. Saline ponds also have a rich and diverse benthic fauna. Polychaete worms, razor clams, blue crabs, hermit crabs, fiddler crabs, mud crabs, and oyster drills are all common. Salinities are too high to produce healthy oysters due to the presence of the oyster drill.

A.5.186. Fish. Forage fish, such as menhaden, anchovies, pinfish, and silversides, are common inhabitants of saline ponds. Sport fish are numerous in saline ponds with spotted and sand seatrout, red and black drum, southern flounder, Atlantic croaker, and spot being harvested. These same species are caught by commercial fishermen. Both adults and young of these species utilize the ponds.

SALINE BAYOUS

A.5.187. General. There are approximately 6,100 acres of saline bayous in the project area. Some of these bayous are shallow, ranging from 3 to 5 feet deep while others, especially those connecting a bay or pond with the gulf, are up to 20 feet deep due to the action of tidal currents. Bottoms are generally clayey silt to silty clay.

A.5.188. Physical and Chemical Characteristics. These parameters are generally similar to those described under saline ponds. However, the deeper bayous are cooler in summer and warmer in winter and thus serve as a refuge for organisms. Suspended solid concentrations are usually higher than in saline ponds.

A.5.189. Flora. The same phytoplankton, filamentous algae, and unicellular algae as occur in saline ponds, occur here.

A.5.190. Fauna. Zooplankton, benthos, and fishes are generally similar to those described in saline ponds. The deeper, wider passes have a characteristic benthic community of brittle stars, sea urchins, and sand dollars. Atlantic bottlenose dolphins are common in saline bayous and passes.

SALINE BAYS

A.5.191. General. Approximately 53,800 acres of saline bays are present in the project area. These bays range from 2 to 6 feet in depth and bottoms are generally silty clay or sandy silt (Barrett et al., 1971). Caillou Bay and Terrebonne Bay are some of the saline bays in the project area.

A.5.192. Physical and Chemical Characteristics. Conditions are very similar to those previously described for saline ponds. Turbidity is occasionally higher than in ponds and temperature ranges are less than in ponds.

A.5.193. Flora. Saline bay flora is very similar to that existing in saline ponds. Beds of shoal grass and turtle grass are often found in protected areas on the north side of barrier islands. These grass beds are prime nursery habitat for young of many species, including spotted seatrout.

A.5.194. Fauna. Fauna is similar to that described for saline ponds. More gulf fishes and shellfishes are present in the saline bays than in saline ponds because of the easy access from the gulf. Saline bays are also a nursery area for numerous fish and shellfish important to human beings.

OPEN GULF

A.5.195. General. There are approximately 804,000 acres of open gulf in the project area. Since the gulf itself will be only minimally impacted by the project, only a brief description of its flora and fauna is necessary. The gulf in the project area varies from the shoreline to a depth of 22 feet. Bottoms are mainly sand, but silt and clay bottoms also occur.

A.5.196. Physical and Chemical Characteristics. Suspended solid levels are very low in gulf waters much of the year. However, during periods of high river discharge, levels rise especially near shore. Temperatures vary with depth and season. Salinities are generally near 32 ppt except at times of high river discharge. Gulf salinities in portions of the project area located south and southwest of Atchafalaya Bay are much lower than those outside of the river's

influence. For example, salinities in the shallow gulf waters east of Four League Bay, which are not greatly influenced by Atchafalaya River discharge, are considerably higher than those west of Four League Bay.

A.5.197. Flora. The clear gulf waters have a moderately rich phytoplankton fauna, including genera such as Coscinodiscus, Skeletonema, and Chaetoceros.

A.5.198. Zooplankton. A variety of organisms comprise the gulf zooplankton. Copepods, such as Acartia, Tortanus, and Temora, are common, but large numbers of crab zoea, shrimp larvae, arrowworms, and oyster and snail larvae are present.

A.5.199. Benthos. The benthos of the gulf is exceedingly varied and communities can be differentiated on the basis of substrate and depth.

A.5.200. Fish and Other Marine Vertebrates. There are numerous kinds of fish, such as groupers, jacks, pompano, tuna, marlin, and tarpon in the gulf that do not occur, or rarely occur, in estuaries. Nearly all the species previously discussed under brackish and saline areas are also present in the gulf. Numerous shore birds, whales, porpoises, and sea turtles also utilize this habitat.

Cultural Resources

A.5.201. Archeological surveys in the Atchafalaya Basin have resulted in the discovery of hundreds of sites. To date, these surveys have been predominantly site specific; that is, they have concentrated on known sites and have not been directed toward a thorough search of known or suspected cultural areas. Systematic and thorough surveys, which should correct this situation, have been relatively few in the study area. Additionally, thorough on-the-ground search of certain localities is not a foolproof method of discovering all or even most archeological sites. No evaluative program has been tried which would give information about the representativeness of the site sample compared with the number of sites (e.g., buried by alluviation, etc.) that are really present. Because many surveys were guided by aims other than the production of site distributional information, they have not been effective in collecting archeologically useful data on siteless (or presumed siteless) areas, an absolute necessity to analyses of spatial distributions. The site distribution pattern in the Atchafalaya Basin is a pattern produced by intensive efforts in a few corridors, preconceived assumptions by investigators, and the masking of the terrain by geomorphic activity (in some cases, mound sites 3 to 6 meters high reported in 1913 have disappeared). It is not a pattern that truly reflects the dispersion of archeological sites and should not be regarded as such.

A.5.202. Some 252 sites have been recorded (taken from site map files of the State Division of Archaeology and Historic Preservation and US Army Corps of Engineers, New Orleans District) in the Atchafalaya Basin area. A discussion of the nature of these sites follows.

THE NATURE OF ARCHEOLOGICAL SITES IN THE BASIN

A.5.203. The archeological sequence for southeastern Louisiana in which manifestations exist are generally organized into six major units. A brief summary of these divisions follows (modified from Newman, 1976).

A.5.204. Paleo-Indian (10,000 B.C. - 6,000 B.C.). Diagnostic traits include bifacially chipped, lanceolate projectile points with or without flutes extending up from a straight or concave base, along the longitudinal axis of the points. The fluting may be bifacial or unifacial.

A.5.205. Subsistence economy was based on hunting and gathering. Excavated sites reveal artifacts in association with terminal Pleistocene megafauna.

A.5.206. The settlement pattern, revealed in archeological deposits, generally consisted of small temporary campsites near or along the edges of springs.

A.5.207. Archaic (6,000 B.C. - c. 550 B.C.). Diagnostic traits include a greatly expanded chipped stone and ground stone inventory, common throughout the Archaic, and includes medium to large stemmed, triangular projectile points, side and end scrapers, perforators and drills, bifacial 'knives', ground stone beads, celts, plummets, steatite vessels and effigies. Clay figurines and shell ornaments, an expanded bone industry that includes antler atlatl hooks and bone awls, a wide range of baked clay objects, and the importation of exotic raw stone material were added by the terminal Archaic Poverty Point culture group.

A.5.208. Subsistence economy consisted of hunting, gathering, and collecting. No physical evidence of a cultivated or domesticated food base is known.

A.5.209. Settlement patterns of this period include large earthworks at the Poverty Point site, West Carroll Parish, comprised of a mound and concentric semi-circular ridges that were occupied. A low-domed, earthen tumulus was tested on Avery Island; also, several campsite deposits of this period were examined in the Lake Pontchartrain area. A series of seven low earthen mounds built in a circular

pattern is known as the Pickett Island site, Catahoula Parish. At the Monte Sano Site, East Baton Rouge Parish, excavations revealed remains of a structure having a square floor pattern. An earthen midden located on an inset terrace remnant is present to the west of the Atchafalaya Basin in St. Landry Parish.

A.5.210. Tchefuncte (c. 550 B.C. - A.D. 250). Diagnostic traits of the Tchefuncte culture include the first major introduction of pottery. Vessels are conical with multi-form, tetrapodal bases. Incised, brushed, punctated and stamped decorative motifs appear on the vessel bodies and rim exteriors. A thick, red slip is present on some plain vessels. Decorated tubular, clay pipes are also introduced. Chipped and ground stone, bone and shell implements, and baked clay objects are common. These latter forms are similar to those of the terminal Archaic period, but are generally less plentiful, variable, or ornate.

A.5.211. Subsistence economy during the Tchefuncte period consisted of hunting, gathering, and collecting, with a probable trend toward broad-spectrum subsistence pursuits, which include a cultivated and possibly domesticated food base. Indications of horticulture can be seen in Tchefuncte deposits at the Mortin Shell Mound, Iberia Parish and the Bayou Jasmine site, St. John the Baptist Parish.

A.5.212. The settlement pattern exhibited during this period consists of numerous sites in the marsh areas of southern Louisiana that are characterized as shell and organic middens. Inland sites most numerous along the prairie terrace to the west of the Atchafalaya Basin (Teche-Vermilion Watershed), principally consist of small, low, earthen mounds, and middens. Gibson (1980) has confirmed Tchefuncte presence in the basin at several sites including 16 IV 4 (Bayou Sorrel Mounds).

A.5.213. Marksville (A.D. 250 - A.D. 700). Diagnostic traits of this culture include new pottery types comprised of bowls, globular and jar-shaped vessels that are elaborately decorated on the exterior with punctated, incised and stamped motifs. Vessels may also be decorated with red pigment and stylized zoomorphic motifs. Ground stone and ceramic platform pipes and effigies are present. Artifacts of exotic raw materials including copper, quartz crystals, asphaltum and galena are often present in sites of this period.

A.5.214. Subsistence economy during this period consisted of broad spectrum hunting and collecting, augmented by a probable domesticated food base. Evidence of corn and squash are purported from the Marksville site, Avoyelles Parish.

A.5.215. Settlement patterns are somewhat varied; one extensive occupation, the Marksville site, consists of a group of earthen mounds within a semicircular, ridged, earthen wall. Domed mounds contain a

central chamber for the disposal of the dead. Human interments, both primary and secondary, are deposited along with a selected quantity of pottery, chipped and ground stone, bone, shell, and copper funerary offerings. Other sites consist of middens and/or mounds with no visible evidence of palisades or enclosures. Evidence of a possible habitation structure, rectangular in plan with a semisubterranean floor, was exposed at the Marksville site.

A.5.216. Troyville-Coles Creek (A.D. 700 - A.D. c. 1100). Diagnostic traits of this culture include the introduction of clay as a ceramic tempering agent; also the development of new decorative designs and vessel shapes is characteristic of this period. Simple incising on a wide variety of rims marks the earlier forms, while incising, punctating, and check-stamping become dominant later. This period is also marked by an expansion in bowl and platter (plate) vessel shapes. Elbow-shaped clay pipes, ear spools, and grinding stones become important features. Toward the end of this period, the preponderance of small, finely chipped projectile points probably indicates the introduction of the bow and arrow, whereas previously the atlatl predominated.

A.5.217. The subsistence economy was based upon corn and squash agriculture; subsistence pursuits were supplemented by broad-spectrum hunting and gathering.

A.5.218. The settlement pattern is characteristically three large, pyramidal, compound mounds oriented around an open plaza. Houses have either rectangular or oval floor patterns. Mounds of the Troyville site, Catahoula Parish, were within a large, rectangular ditch (moat) and earthen enclosure. Multiple primary and secondary human interments, generally without artifactual associations, are common features in the mounds.

A.5.219. Plaquemine - Mississippian (A.D. 1100 - A.D. 1700). Diagnostic traits include new ceramic typologies, shell-tempered pottery, effigy vessels, new decorative motifs, strap handles, effigy pipes, and ear spools which characterize this period. Complicated stamped designs are present during the earlier phases, with curvilinear designs predominating later. Late in the period, native artifacts are found in association with European trade goods. "Southern Cult" artifacts are also present in some sites.

A.5.220. Subsistence economy was primarily corn, bean, and squash agriculture that was supplemented by seasonal hunting and collecting.

A.5.221. The settlement pattern consisted of large, compound, pyramidal mounds oriented around an open plaza, characteristic of the larger sites. Mounds may have stepped ramps. Round, rectangular and square structure floor patterns, with or without wall trenches. Some villages are surrounded by wooden palisades. Secondary single and

multiple bundle burials occur in the mounds. Primary, flexed, human interments are also present. Gibson (1980) makes a strong case that the Chitimacha Indian village of Ama' tpan na' mu is at the site of 16 SMY 2 (Charenton Beach).

A.5.222. The preceding categories are generalizations of "cultures" and types of sites to be found in the Atchafalaya Basin. The number of previous archeological investigations within and near the Atchafalaya Basin give the impression that the prehistory of the great swamp is well known. This is simply not the case. The above presentation is an illustration in itself of one problem in the archeology of the basin. To describe the archeology of the basin requires the imposition of culture sequences originated in regions outside the basin and adoption of several concomitant assumptions about culture processes, assumptions whose validity for archeological reconstructions may be questioned.

A.5.223. When Indians first moved into the Atchafalaya Basin is open to considerable conjecture. As a matter of fact, the topic cannot even be considered until one specifies which paleogeographic stage of basinal development is being discussed.

A.5.224. No residues from Paleo-Indian activities are known within the present-day Atchafalaya Basin. But does this imply their absence or merely that the land surfaces that might have borne these evidences have been eliminated or buried by river channel shifts since Paleo-Indian times? Characteristic Paleo-Indian artifacts, mainly projectile points, have been found on Godeau Hill and Evergreen Island on the western edge of the modern Atchafalaya Basin. They seem to be associated with a relict, resculptured Mississippi River meanderbelt (i.e., the Lafayette-Mississippi meanderbelt), which has been entirely obliterated from the contemporary surface of the Atchafalaya Basin.

A.5.225. A similar conclusion can be reached concerning Archaic components. Although Archaic sites have been identified in the upper part of the basin, they all seem to lie along older, elevated landforms that have remained relatively untouched by subsequent degradation or aggradation within the swamp itself. One such component is site number 16 AV 33. Superficially, 16 AV 33 appears to be connected with the Bayou Jack segment of the Teche-Mississippi course that Saucier (1974) believed to have been active about 6,000-4,000 B.C. However, sediments and soils at the location hint of a far more complicated geomorphic picture, one that may have involved an ancestral meanderbelt of the Arkansas River. Archaic sites are densely located along the exposed natural levees of Big Darbonne Bayou, implying that the bayou was a significant water course during an earlier phase of its existence. Gagliano et al., (1978) suggests that Big Darbonne Bayou may have been a major crevasse system off the Teche-Mississippi system.

A.5.226. South of US Highway 190, no Archaic sites have been identified within the basin proper, although they do parallel the swamp margins atop the Mississippi alluvial valley walls themselves. In other words, they overlook the swamp but seemingly do not extend out into it. This may seem unusual because the Teche Ridge, the elevated meanderbelt of the Teche-Mississippi River system, which apparently supports Archaic components in the upper reaches of the Atchafalaya Basin, is well preserved to the vicinity of modern-day Berwick and Morgan City.

A.5.227. Until Gibson's (1980) survey of the East-West Atchafalaya Protection Levees, it was believed that Tchefuncte settlements were also missing in the Atchafalaya Basin. Now it is known that they do exist. They appear in high densities along the western edge of the basin flanking the Bayou Jack, Bayou Rouge, and Petite Prairie meanderbelts. From Bayou Courtableau (US Highway 190) south to Berwick, near the southern end of the swamp, they seem to be more scattered but are nonetheless present. This survey, in fact, confirmed Tchefuncte components on the eastern flank of the Teche Ridge at Bayou Perronet (16 SM 50), Charenton Beach (16 SM 2), and Mocassin (16 SMY 104). The Lake LaRose Mounds (Moore 1913), in the middle of the swamp about 12 kilometers (km) southeast of Bayou Perronet, may also have a Tchefuncte component. On the eastern perimeter of the basin, Tchefuncte occupation may be present at Bayou Sorrel Mounds (16 IV 4) and the Schwing Place (Moore, 1913). Both of these sites, however, appear to be positioned atop stable, elevated, remnant landforms, presumably formed by early Mississippi River alluviation, perhaps the Maringouin-Mississippi River. By normal archeological criteria, Poverty Point components are difficult to identify in many localities in south central Louisiana. This is probably a function of distance (300-400 km) from the Poverty Point localities on the Macon ridge in extreme northeastern Louisiana and western Mississippi where typological details for culture unit attribution were originally extracted. Population enclaves in south central Louisiana, which were contemporary with the Poverty Point developments upvalley, were simply doing things in their own time-honored, traditional manner that had proved adaptively successful to them and their ancestors. However, by stretching typological criteria and emphasizing the presence of exotic trade materials, it is possible to ascribe some Atchafalaya edge components to the Poverty Point culture period. The Stelly mound group on Bayou Petite Prairie, near the Bayou Jack-Bayou Rouge meander complex (Teche-Mississippi meanderbelt), seems to be a local center of activities during Poverty Point times. Farther down the valley escarpment in the vicinity of Lafayette, Louisiana, there is another cluster of sites, which temporarily and, to an attenuated degree, culturally equate to the Poverty Point culture period.

A.5.228. There are similar typological and interpretive problems found in dealing with the Marksville, Coles Creek-Troyville, and Plaquemine-Mississippian "cultures."

A.5.229. In short, very little is known about substantive prehistory in the Atchafalaya Basin and, in many cases, what is known is not based on findings from the basin proper but from outside regions so distinctive from the swamp that applicability may be questioned. Virtually every aspect of Atchafalaya prehistory is at issue, from chronological segmentation and culture unit systemization to simple descriptive and reconstructive categories dealing with settlement subsistence and higher-order levels of cultural interest. Because the state of understanding is so germinal and the technical problems with acquiring representative information are so numerous, it would be pretentious to claim that the Atchafalaya Basin has contributed greatly to the explication of culture change, evolution, and historical events among native American populations in the Lower Mississippi Valley.

A.5.230. It does appear certain that the uniqueness of the region demands unique archeological perceptions and interpretations. Thus great care must be exercised in determining the significance of sites and their disposition.

FOLK CULTURE

A.5.231. A unique folk culture based upon exploitation of swamp resources developed in the basin in the mid-1800's. Although some swamp dwellers spoke English, most were French-speaking Acadians. Agricultural pursuits on the natural levees of Bayous Chene and Sorrel in the basin began in the early nineteenth century. The extractive economy emerged in the basin as the result of many historical factors. Many of the original Acadian settlers of southwestern Louisiana were dislocated by expansion of the Anglo-plantation system and forced to reside on low natural levees in the swamp. The marginally successful agriculture in the basin was disrupted by the Civil War and the clearing of the Raft (1840-1861). The basin's inhabitants first supplemented their garden foods and many turned completely toward extraction of wild resources, such as crawfish, moss, cypress, fish, frogs, etc.

NATIONAL REGISTER SITES

A.5.232. The National Register of Historic Places as published in the "Federal Register," dated 6 February 1979, and the monthly supplements through 28 September 1981, have been consulted and two archeological sites, which are located within the Atchafalaya Basin Floodway, have been determined eligible for inclusion in the National Register. The Nutgrass site, 16SM45, is an important shell midden located on the west bank of the Port Allen-Morgan City Intracoastal Canal south of Belle River Landing, Louisiana. Subsequent to its determination of eligibility to the National Register, the Nutgrass site was protected from further erosion in 1975 by placement of stone on the bank and

adjacent underwater slope by the US Army Corps of Engineers. An intensive cultural resources survey of the Atchafalaya Basin Floodway Levees was conducted by the University of Southwestern Louisiana in 1979 - 1980, and located eleven (11) significant cultural resources possibly eligible for inclusion in the National Register. One (1) of these, the Avoca Island Pumping Plant Number 1 (16 SMY 52), was determined eligible for inclusion on 14 September 1981. Upon a slight modification of project design, a determination of no effect was completed on 14 September 1981. Additionally, numerous historic resources located on the Bayous Grosse Tete, Lafourche, and Teche natural levee ridges bordering the Atchafalaya Basin have been included in the National Register of Historic Places.

NATIONAL TRUST PROPERTIES

A.5.233. The only National Trust property located in Louisiana is Shadows-on-the-Teche, located on Bayou Teche in Iberia Parish west of the Atchafalaya Basin. Built between 1831-1834 in New Iberia, it is a two-story, porticoed mansion with eight giant Tuscan columns and a second floor veranda.

HISTORIC SITES

A.5.234. In addition to the National Register and National Trust properties mentioned, over one-quarter of the 252 sites previously stated contain historic components. Even larger numbers can be anticipated, as historic sites have not received the attention accorded to prehistoric sites.

A.5.235. The considerable number of ship disasters and military sinkings of vessels during the Civil War point to a high probability of encountering subsurface or underwater ship remains. A reliable listing of ship losses has yet to be assembled.

Human Resources

A.5.236. The socioeconomic information on the study area is the aggregate for the area comprised of the following Louisiana parishes: Assumption, Avoyelles, Caldwell, Catahoula, Concordia, Franklin, Iberia, Iberville, Lafourche, La Salle, Pointe Coupee, Ouachita, Richland, St. Landry, St. Martin, St. Mary, Tensas, Terrebonne, and West Baton Rouge. The economic study area is shown on Figure A-5-12.

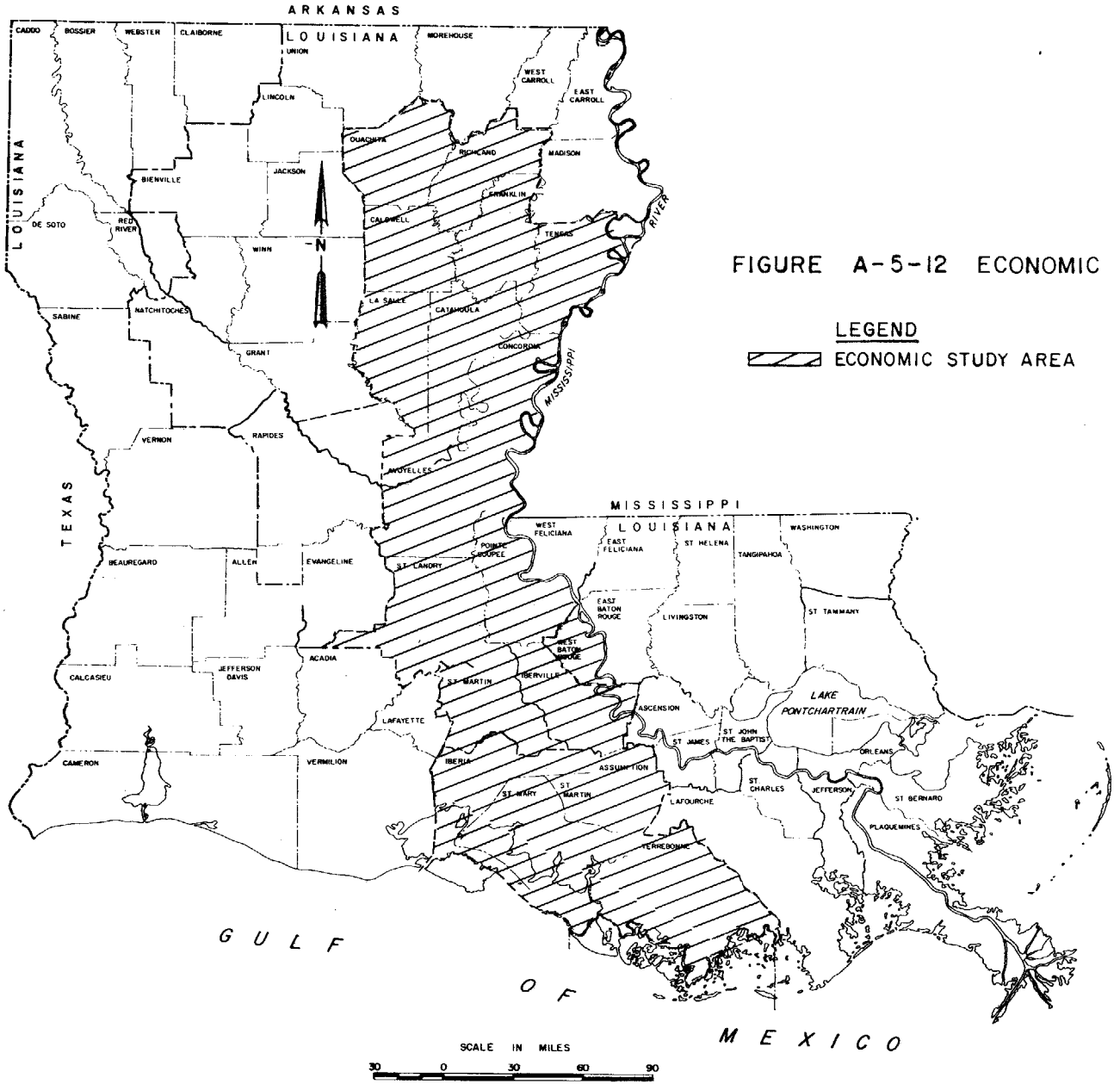


FIGURE A-5-12 ECONOMIC STUDY AREA

LEGEND

ECONOMIC STUDY AREA

Population Characteristics

A.5.237. In 1970 the population contained within that portion of the Atchafalaya Basin Floodway system not protected by ring levees was approximately 4,600 with the heaviest concentration consisting of scattered developments in the West Atchafalaya Floodway, extending along the alluvial bank of the Atchafalaya River. Additional small settlements of camp-type homes are situated in the Lower Atchafalaya Basin Floodway at Butte La Rose and on the floodway side of the levees in the general vicinity of Morgan City.

A.5.238. As shown in Table A-5-21, the population within the economic study area has increased from 575,000 to 757,000 persons during the 25-year period from 1950 to 1975. This increase represents an annual compound growth rate of 1.1 percent as compared with the Louisiana and national rates of 1.4 percent for the same period. The 1950-60 decade was the period of most rapid growth. During that time, the population grew at a 1.5 percent rate. This rapid population growth coincided with burgeoning development of coastal Louisiana's onshore and offshore petroleum resources. Since 1960, the increase has slowed to an annual rate of about 0.8 percent.

A.5.239. Between 1950 and 1960, the economic area as a whole experienced net out-migration at a rate of 8.9 percent. Net migration varied by parish between minus 31.0 percent to 11.6 percent; two-thirds (2/3) of the parishes had net out-migration. Generally, net out-migration occurred from the interior parishes as a result of the decreased demand for agricultural workers and a general trend toward migration to large urban areas outside the economic area. Coastal parishes experienced net in-migration during this decade as a result of increased demand for labor in connection with petroleum exploration, production, and related service activities. In the decade of the 1960's, the net migration rate for the economic area registered minus 9.4 percent. Net migration rates ranged between minus 34.7 and 0.8 percent; net in-migration was experienced in only two parishes, both of which contained significant petroleum production. While continued net out-migration has generally occurred within the study area since 1970, its magnitude seems to have decreased from previous levels. Between 1970 and 1975, the economic area as a whole experienced net out-migration at a rate of 2.9 percent. Net migration rates varied by parish between minus 9.9 to 6.5 percent with only five of the parishes having net in-migration.

A.5.240. In 1970, the population of the economic area was classified as 46 percent urban, and over 27 percent of the total population resided in eight urban centers: Eunice (11,390); Houma (30,922); Monroe (56,374); Morgan City (16,586); New Iberia (30,147); Opelousas (20,121); Thibodaux (14,925); and West Monroe (14,868). It should be

TABLE A-5-21

POPULATION DATA
(In Thousands)

Parish	Total Population				Net Migration Rate 1/		
	1950	1960	1970	1975	1950-60	1960-70	1970-75
Assumption	17,278	17,991	19,654	20,419	-16.1	-8.7	-3.8
Avoyelles	38,031	37,606	37,751	38,171	-20.5	-12.1	-3.8
Caldwell	10,293	9,004	9,354	10,156	-25.9	-3.8	-5.7
Catahoula	11,834	11,421	11,769	11,397	-25.8	-11.5	- 8.9
Concordia	14,398	20,467	22,578	21,628	-10.5	- 9.0	- 9.9
Franklin	29,376	26,088	23,946	23,523	-33.6	-21.2	- 7.0
Iberia	40,059	51,657	57,397	61,096	- 2.0	-10.5	- 0.8
Iberville	26,750	29,939	30,746	30,601	- 7.9	-13.0	- 5.8
Lafourche	42,209	55,381	68,941	72,445	3.9	0.8	- 1.8
LaSalle	12,717	13,011	13,295	14,619	-15.6	- 8.9	- 6.5
Ouachita	74,713	101,663	115,387	125,447	11.6	- 3.5	2.6
Pointe Coupee	21,841	22,488	22,002	21,855	-22.1	-21.1	- 5.6
Richland	26,672	23,824	21,774	21,683	-23.7	-34.7	- 4.5
St. Landry	78,476	81,493	80,364	80,553	-21.9	-19.4	- 6.4
St. Martin	26,353	29,063	32,453	34,436	-16.7	- 7.8	- 1.1
St. Mary	35,848	48,833	60,752	60,680	- 9.1	0.7	- 7.3
Tensas	13,209	11,796	9,732	8,723	-31.0	-28.9	-15.5
Terrebonne	43,328	60,711	76,049	81,791	7.2	- 1.7	1.3
West Baton Rouge	11,738	14,796	16,864	17,522	1.7	- 8.4	- 2.7
TOTAL	575,123	667,292	730,808	756,745	- 8.9	- 9.4	- 2.9
LOUISIANA	2,683,516	3,257,022	3,641,306	3,791,000	- 1.9	- 4.0	- 1.0

1/ Net migration represents the difference between the number of persons moving into a particular area and the number of persons moving away from the area. Net migration was estimated by subtracting natural increase (the difference between the number of births and deaths) from the net population change.

Source: US Department of Commerce, Bureau of the Census, "County and City Data Book, 1977."

noted that the major urban centers of Lafayette (68,908) and Baton Rouge (165,963) are located adjacent to the economic study area.

A.5.241. The study area comprises 29 percent of total land in the State of Louisiana and accounted for 20 percent of its population in 1975. This area is a significant part of Louisiana as it contains almost one-third of total state land and nearly one-fourth of the entire population.

MAJOR SKILLS AND OCCUPATIONS

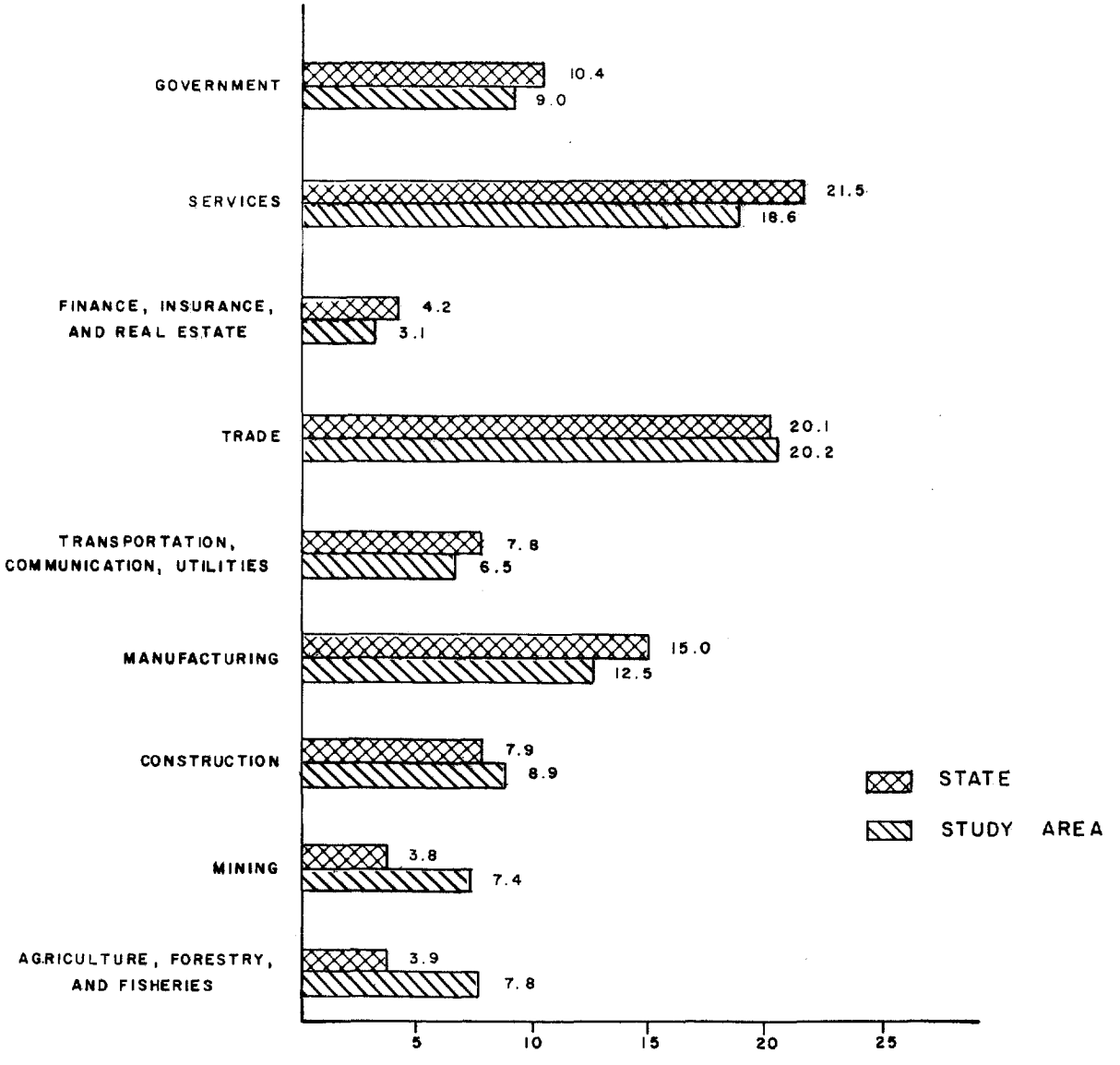
A.5.242. Study area employment in 1970 was concentrated in trade, services, manufacturing, government, construction, agriculture, forestry, fisheries, and mining. Jobs in transportation, communications, utilities, finance, insurance, and real estate were also extant in 1970, but to a lesser degree than those previously discussed. Study area employment was more concentrated in agriculture, forestry, fisheries, and mining in 1970 relative to comparable statewide data. About 24.1 percent of the study area civilian labor force was employed in these industry sectors while the statewide average was about 15.6 percent.

A.5.243. The percentages of the population employed in major skills and occupations in the state and study area are compared in Figure A-5-13.

A.5.244. Table A-5-22 provides, by parish, a tabulation of the study area civilian labor force in 1970 and includes a greater proportion of blue-collar and farm workers (43.6 percent) in comparison to the statewide average for such employment (37.2 percent). Among the experienced unemployed in 1970, again the study area civilian labor force included a higher proportion of blue-collar and farm workers (3.3 percent) relative to the state (2.7 percent).

EDUCATION

A.5.245. In 1970 the median number of school years completed among persons 25 years and over averaged 12.2 years nationally while the comparable Louisiana figure was 10.8 years. Except for Ouachita Parish (Monroe area), all parishes within the study area were below the state in median number of school years completed among persons 25 years and over. Such information for the US, state, and study area by sex is shown in Table A-5-23.



SOURCE: U.S. DEPT. OF COMMERCE, BUREAU OF CENSUS, "GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, LOUISIANA, 1970."

FIGURE A-5-13 AREAS OF EMPLOYMENT

TABLE A-5-22

CIVILIAN LABOR FORCE CHARACTERISTICS (1970)

Parish	Civilian Labor Force			Employed[1]					Experienced Unemployed[2]				
	Total	Male	Female	Total	White Collar	Blue Collar	Farm Workers	Service Workers	Total	White Collar	Blue Collar	Farm Workers	Service Workers
Assumption	5,291	4,051	1,240	4,929	1,172	2,409	720	628	347	37	197	78	20
Avoyelles	10,806	7,568	3,238	9,859	3,774	3,067	1,348	1,670	846	103	518	107	108
Caldwell	2,849	1,913	936	2,700	851	979	273	597	132	13	76	12	31
Catahoula	3,278	2,271	1,007	3,091	941	1,184	463	503	164	16	99	14	35
Concordia	7,276	4,684	2,592	6,807	2,603	2,490	606	1,108	426	70	209	37	95
Franklin	6,792	4,405	2,387	6,319	2,154	2,053	1,261	851	423	48	201	80	94
Iberia	18,456	12,638	5,818	17,346	6,374	7,248	914	2,810	939	185	485	61	193
Iberville	8,863	5,936	2,927	8,018	2,558	3,341	475	1,644	730	88	478	27	120
Lafourche	21,900	16,347	5,553	20,964	7,880	9,538	758	2,788	855	97	510	47	144
LaSalle	4,080	2,909	1,171	3,810	1,252	2,013	35	510	239	34	150	0	35
Ouachita	41,595	25,371	16,224	39,340	19,398	12,993	478	6,471	2,005	622	961	15	379
Pointe Coupee	6,084	4,270	1,814	5,510	1,729	2,151	798	832	491	85	276	25	101
Richland	6,225	3,995	2,230	5,849	1,888	2,113	985	863	346	56	175	66	46
St. Landry	22,120	15,366	6,754	20,569	7,146	7,907	2,094	3,422	1,334	159	823	97	250
St. Martin	8,971	6,336	2,635	8,301	2,495	3,596	823	1,387	626	68	449	45	57
St. Mary	20,094	14,050	6,044	19,130	7,818	8,016	725	2,571	846	215	374	88	143
Tensas	2,525	1,708	817	2,388	653	580	663	492	133	7	47	49	30
Terrebonne	23,737	17,348	6,389	22,958	9,219	10,505	458	2,776	731	168	437	10	112
West Baton Rouge	4,982	3,437	1,545	4,583	1,524	2,134	257	668	332	71	163	33	65
TOTAL	225,924	154,603	71,321	212,471	81,429	84,317	14,134	32,591	11,945	2,142	6,628	891	2,058
% of Civilian Labor Force	100.0	68.4	31.0	94.0	36.0	37.3	6.3	14.4	5.3	0.9	2.9	0.4	0.9
LOUISIANA	1,224,186	788,384	435,802	1,158,245	523,887	418,293	37,144	178,291	59,089	14,496	30,022	1,938	11,316
% of Civilian Labor Force	100.0	64.4	35.6	94.6	42.8	34.2	3.0	14.6	4.8	1.2	2.5	0.2	0.9

[1] White Collar - professional, technical, and kindred workers; managers and administrators, except farm; sales workers; and clerical and kindreds.
Blue Collar - craftsmen and kindred workers; operatives, except transport; transport equipment operatives; and laborers, except farm.
Farm Workers - farmers and farm managers; farm laborers and farm foreman.
Service Workers - service workers including private households.

[2] Includes persons who last worked more than 10 years ago, not shown separately.

Source: US Department of Commerce; Bureau of the Census, "General Social and Economic Characteristics, Louisiana, 1970."

TABLE A-5-23

EDUCATIONAL CHARACTERISTICS

Area	Persons 25 Years and Over Median School Years Completed		
	Males	Females	Total
Assumption	7.2	7.9	7.5
Avoyelles	8.3	8.9	8.6
Caldwell	8.7	10.4	9.7
Catahoula	8.8	9.8	9.3
Concordia	9.6	10.2	9.9
Franklin	8.4	9.3	8.9
Iberia	9.1	9.5	9.4
Iberville	8.5	8.9	8.7
Lafourche	8.4	8.6	8.5
LaSalle	9.6	10.7	10.2
Ouachita	11.7	11.7	11.7
Pointe Coupee	8.0	8.4	8.2
Richland	8.6	9.2	8.9
St. Landry	7.6	8.1	7.8
St. Martin	6.9	7.9	7.5
St. Mary	9.8	10.0	9.9
Tensas	7.7	8.1	7.9
Terrebonne	9.2	9.8	9.6
West Baton Rouge	10.1	10.1	10.1
LOUISIANA	10.7	10.8	10.8
UNITED STATES	12.2	12.2	12.2

Source: U.S. Department of Commerce, Bureau of the Census, "Statistical Abstract of the U.S., 1976."

U.S. Department of Commerce, Bureau of the Census, "General Social and Economic Characteristics, Louisiana, 1970."

Development and Economy

A.5.246. The general area of direct economic impact includes the gently rolling terrain north of the floodway system, the floodway system and adjacent alluvial ridges, and the coastal marshes to the south. The economic area comprises approximately 9.1 million acres, or 29 percent of the state's total area, and contains about 36 percent of statewide marshlands.

A.5.247. More than 30 percent of the state lands devoted to agricultural use lie within the economic area. This large percentage has been achieved by intensive utilization of the alluvial ridge lands lying along the rivers and bayous, and reclamation of sizable swamp and marsh areas.

A.5.248. The percentage of urban land and transportation network development throughout the economic area is disproportionately low relative to that of the state. This is primarily attributable to the large acreage low-lying areas in the coastal region that are of limited utility for these purposes.

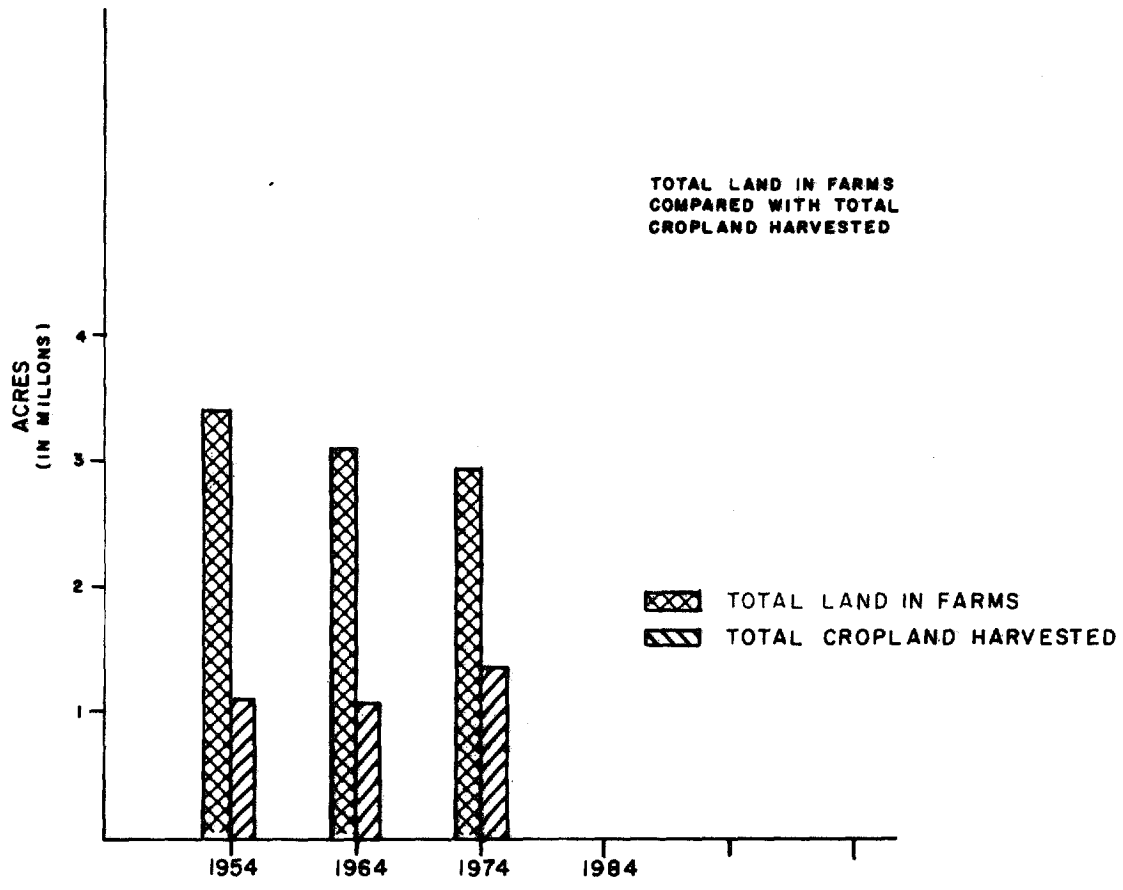
RURAL AND AGRICULTURAL DEVELOPMENT

A.5.249. Agricultural activity within the economic area, the importance of which is indicated in the aforementioned land-use description, is related almost solely to crop production, primarily soybeans, sugarcane, cotton, hay, and corn, in order of harvested acreages. About 3 million acres are in farms (Table A-5-24), almost half of which is comprised of harvested cropland. The value of all farm products sold in 1974, shown in Table A-5-25, was $456.7 million, with $421.9 million of this amount, or 92 percent, attributable to crop sales. The 1964-74 period was characterized by increased emphasis on crop production within the economic area, accounting for a sizable portion of the increase.

A.5.250. While total land in farms decreased from 1954 to 1974, total cropland harvested increased during the same period (Figure A-5-14).

URBAN DEVELOPMENT

A.5.251. There are no major urban areas in the Atchafalaya Basin Floodway System, although the Morgan City-Berwick-Patterson complex of cities, sits astride the southern end of the Lower Atchafalaya Basin Floodway. These cities are the focal point for the industrial, marine, and energy firms engaged in offshore exploration and production of oil and gas resources in the Louisiana gulf region. Other urban centers located in the backwater area parishes northeast of



SOURCE: U.S. DEPT. OF COMMERCE, BUREAU OF CENSUS, "CENSUS OF AGRICULTURE, LOUISIANA" 1974, 1969, 1959.

FIGURE A-5-14 AGRICULTURAL LAND

TABLE A-5-24

AGRICULTURAL LAND
(In Acres)

Parish	Total Land in Farms			Total Cropland Harvested		
	1954	1964	1974	1954	1964	1974
Assumption	88,315	87,775	79,789	45,751	41,150	40,572
Avoyelles	223,996	233,265	252,410	84,100	86,426	138,291
Caldwell	81,216	73,440	58,350	17,933	18,216	20,769
Catahoula	134,375	132,065	203,925	37,714	41,804	121,119
Concordia	223,481	279,795	216,788	35,552	58,494	109,552
Franklin	329,650	305,645	296,567	119,161	129,995	172,229
Iberia	133,410	133,985	115,230	65,343	58,413	54,692
Iberville	134,561	123,265	116,201	36,814	32,371	38,794
Lafourche	230,790	225,015	215,099	57,360	50,798	44,385
LaSalle	35,274	28,357	17,739	3,243	2,329	2,736
Ouachita	175,069	127,935	91,540	35,454	35,985	35,796
Pointe Coupee	240,730	221,155	194,516	54,290	51,551	61,527
Richland	268,407	248,175	273,687	104,110	104,445	146,088
St. Landry	328,024	330,015	302,484	155,267	131,035	168,723
St. Martin	130,097	108,365	92,403	70,019	48,607	38,471
St. Mary	162,162	123,285	115,581	54,782	48,543	50,267
Tensas	250,373	218,435	229,441	65,640	65,044	114,502
Terrebonne	116,627	123,415	62,297	26,821	27,480	21,957
West Baton Rouge	55,198	47,536	38,728	20,899	16,928	18,260
STUDY AREA	3,341,755	3,170,923	2,972,775	1,090,253	1,049,614	1,398,730
Percent of State	29.2	32.4	32.6	36.2	39.3	39.5
LOUISIANA	11,441,343	9,788,662	9,111,853	3,010,580	2,672,650	3,541,074

Source: US Department of Commerce, Bureau of the Census, "Census of Agriculture, Louisiana, 1974, 1969, 1959."

TABLE A-5-25

VALUES OF AGRICULTURAL PRODUCTION
(In Thousands of Dollars)

Parish	Value of All Agricultural Products Sold			Value of All Crops Sold			Value of All Livestock, Poultry and Related Products Sold		
	1954	1964	1974	1954	1964	1974	1954	1964	1974
Assumption	$ 5,364	$ 6,617	$ 37,831	$ 5,226	$ 6,423	$ 37,689	$ 138	$ 182	$ 142
Avoyelles	8,987	9,331	32,360	7,475	7,051	29,055	1,511	2,254	3,283
Caldwell	1,749	2,548	4,328	1,433	2,124	3,425	316	394	822
Catahoula	3,150	4,604	20,961	2,548	3,743	19,428	601	833	1,507
Concordia	3,413	5,584	19,677	2,643	4,015	18,226	771	1,501	1,348
Franklin	8,862	15,459	29,239	7,323	13,212	25,820	1,539	2,179	3,348
Iberia	6,086	8,809	43,954	5,088	6,966	41,583	1,047	1,804	2,371
Iberville	3,702	4,482	25,366	3,040	3,790	24,474	661	664	870
Lafourche	5,329	7,156	35,426	4,897	6,708	34,206	432	448	1,189
LaSalle	328	491	901	96	137	248	232	333	646
Ouachita	4,022	5,939	7,819	3,024	4,320	5,468	998	1,540	2,336
Pointe Coupee	5,390	5,748	18,300	4,150	3,686	15,575	1,240	1,989	2,707
Richland	7,571	12,444	26,447	6,539	10,556	21,365	1,032	1,864	4,991
St. Landry	16,772	14,292	38,240	14,967	11,383	33,268	1,805	2,854	4,875
St. Martin	6,095	5,457	18,877	5,477	4,404	17,840	618	1,045	1,036
St. Mary	4,600	6,432	44,552	4,473	6,333	44,508	126	93	44
Tensas	7,264	7,269	23,835	6,035	6,137	21,717	1,229	1,049	2,075
Terrebonne	2,785	3,434	14,226	2,449	3,167	14,017	336	266	203
West Baton Rouge	2,216	2,432	14,411	1,930	2,023	13,954	286	408	457
STUDY AREA	$103,685	$128,528	$ 456,750	$ 88,763	$106,178	$421,866	$14,918	$ 21,700	$ 34,255
Percent of State	33.5	31.6	39.0	36.7	38.1	46.3	22.0	17.5	13.5
LOUISIANA	$309,791	$406,795	$1,170,846	$241,941	$278,915	$910,477	$67,850	$124,005	$254,340

Source: US Department of Commerce, Bureau of the Census, "Census of Agriculture, Louisiana, 1959, 1969, 1974."

Morgan City are Houma in Terrebonne Parish, and Thibodaux in Lafourche Parish. Urban centers not in the actual floodways but in floodway parishes are New Iberia in Iberia Parish, and Opelousas and Eunice in St. Landry Parish. The urban centers of Monroe and West Monroe are located in the Red River backwater parish of Ouachita.

EMPLOYMENT AND INCOME

A.5 252. The study area has consistently ranked lower than Louisiana in per capita personal income since 1950. As shown in Table A-5-26, in 1974 there were only two study area parishes, Richland and St. Mary, with per capita personal income levels exceeding the comparable state figure of $4,392. Crop production, primarily rice, contributes much of the personal income earned in Richland Parish, while mining, trade, manufacturing, transportation, and services employment contribute heavily to personal income earned in St. Mary Parish.

A.5.253. The study area civilian labor force numbered 225,924 in 1970 (Table A-5-27). The unemployment rate of the study area in 1970, 6 percent, was slightly higher than the comparable statewide figure of 5.4 percent. Avoyelles Parish experienced the highest unemployment rate within the study area, 9.4 percent, while Terrebonne Parish was lowest with a rate of 3.3 percent in 1970. According to data from the Louisiana Department of Employment Security, the study area unemployment rate was approximately 6.3 percent in 1976, which was lower than the comparable statewide figure of 6.8 percent.

TRANSPORTATION

A.5.254. The area abounds with navigable waterways. The Atchafalaya River and associated channels provide a water route extending the length of the floodway system while the deepwater channel of the Misssissippi River lies just east of the area. The shallow-draft GIWW traverses the entire coast, intercepting numerous rivers and bayous and crossing many bays and lakes. Included in this waterway system is an alternate route of the GIWW, which extends some 64 miles from Morgan City to Port Allen, Louisiana. This vital link for the towboat industry provides a shorter and faster route from the Morgan City area to and from the barge-fleeting areas on the Mississippi River. Other natural and manmade channels provide water access to practically all sections of the economic area.

A.5.255. Major offshore large-diameter pipelines, about equally devoted to the transport of natural gas and crude petroleum, supply shore-based terminals that, in turn, supply intrastate and interstate markets with these raw materials. Many miles of small-diameter

TABLE A-5-26

PER CAPITA INCOME
(IN DOLLARS)

Parish	1950	1959	1970	1974
Assumption	$ 736	$1,237	$2 255	$3,770
Avoyelles	663	964	2,130	3,177
Caldwell	813	984	2,145	2 889
Catahoula	694	846	2,269	3,702
Concordia	864	1,271	2,431	4,047
Franklin	692	902	2,220	3,754
Iberia	934	1,390	2,628	3,910
Iberville	690	1,150	2,667	3,981
Lafourche	810	1,484	2,674	4,114
La Salle	945	1,299	2,363	3,465
Ouachita	1,210	1,652	2,860	4,044
Pointe Coupee	604	827	2,296	3,518
Richland	671	909	2.549	4,561
St. Landry	635	905	2,040	3,123
St. Martin	623	713	1,868	2,924
St. Mary	818	1,479	3,020	4,510
Tensas	551	1,029	2,297	4,309
Terrebonne	782	1,442	2,866	4,238
West Baton Rouge	668	1,077	2,556	3,827
TOTAL	$ 792	$1,233	$2,545	$3,852
LOUISIANA	$1,094	$1,369	$3,090	$4,392

Source: US Department of Commerce, Bureau of Economic Analysis, "Per Capita Personal Income, SMSA's Counties and Parishes - Lower Mississippi Region and Adjacent States, 1929-1970;" and US Department of Commerce, Bureau of Economic Analysis, "Local Area Personal Income 1969-1974." Volume 3: Southeastern States.

TABLE A-5-27

EMPLOYMENT DATA (1970)

Parish	Civilian Labor Force	Total Unemployed		Total Employed	Agriculture, Forestry, & Fisheries	Mining	Construction	Manufacturing	Transportation, communications & Utilities	Trade	Finance, Insurance & Real Estate	Services	Government
		Number	Rate										
Assumption	5,291	362	6.8	4,929	937	219	569	1,081	254	670	67	671	461
Avoyelles	10,806	947	8.8	9,859	1,435	241	1,361	877	552	1,916	348	2,055	1,074
Caldwell	2,849	149	5.2	2,700	351	111	283	362	116	431	85	668	293
Catahoula	3,278	187	5.7	3,091	596	188	306	371	160	474	37	590	369
Concordia	7,276	469	6.4	6.807	701	540	505	1,057	492	1,374	168	1,336	684
Franklin	6,792	473	7.0	6,319	1,360	167	518	665	298	1,312	180	1,098	721
Iberia	18,456	1,110	6.0	17,346	1,090	2,673	1,076	2,242	1,073	3,894	486	3,531	1,281
Iberville	8,863	845	9.5	8,018	548	363	1,088	1,361	534	1,297	236	1,820	771
Lafourche	21,900	936	4.3	20,964	1,362	2,191	1,789	3,193	2,045	4,343	512	3,305	2,134
LaSalle	4,080	270	6.6	3,810	84	606	253	907	279	652	61	676	292
Ouachita	41,595	2,255	5.4	39,340	692	402	3,083	6,069	1,663	10,900	2,301	9,771	4,430
Pointe Coupee	6,084	574	9.4	5,510	844	66	913	707	193	1,011	101	1,071	604
Richland	6,225	376	6.0	5,849	1,037	166	558	786	177	1,359	165	980	621
St. Landry	22,120	1,551	7.0	20,569	2,362	1,335	2,901	1,337	1,278	4,478	541	4,158	2,179
St. Martin	8,971	670	7.5	8,301	991	696	1,316	717	488	1,581	191	1,564	757
St. Mary	20,094	964	4.8	19,130	1,120	2,347	1,491	2,647	2,162	3,878	620	3,520	1,045
Tensas	2,525	137	5.4	2,388	707	62	103	181	105	383	52	539	266
Terrebonne	23,737	779	3.3	22,958	1,036	4.255	1,465	2,698	2,480	4,850	687	3,817	1,670
West Baton Rouge	4,982	399	8.0	4,583	309	68	617	1,070	383	774	135	799	423
TOTAL	225,924	13,453	---	212,471	17,562	16,696	20,195	28,328	14,732	45,577	6,973	42,109	20,299
Percent of Civilian Labor Force	100.0	6.0	---	94.0	7.8	7.4	8.9	12.5	6.5	20.2	3.1	18.6	9.0
LOUISIANA	1,224,186	65,941		1,158,245	47,999	46,584	96,609	184,024	95,487	245,661	51,250	263,216	127,415
Percent of Civilian Labor Force	100.0	5.4	---	94.6	3.9	3.8	7.9	15.0	7.8	20.1	4.2	21.5	10.4

Source: US Department of Commerce, Bureau of the Census, "General Social and Economic Characteristics, Louisiana, 1970."

pipelines connect producing natural gas and crude oil wells with collection facilities for transport to processing and refining plants.

A.5.256. Extensive railroad facilities in the area include routes of the Missouri Pacific, Southern Pacific, Texas and Pacific, and the Kansas City Southern Lines. The Missouri Pacific routes are generally located in the northern portion of the study area and include a connection between the towns of Monroe and Alexandria. One line of the Missouri Pacific is located in the southern portion of the economic area in an east-west direction between Baton Rouge and Opelousas. The Southern Pacific Line skirts the westernmost edge of the study area, connecting Alexandria, Opelousas, Lafayette, New Iberia, Franklin, and Patterson. The route turns eastward through the coastal region, extending through Morgan City and Thibodaux, then to New Orleans. Texas and Pacific, and Kansas City Southern Lines lie in close parallel with the eastern boundary of the study area from Alexandria to the vicinity of Baton Rouge, proceeding along both banks of the Mississippi River to New Orleans.

A.5.257. Also, trucking operations supply the population and serve industry and trade. At least 20 motor freight lines provide facilities in the area. Service is available between cities within the economic area and to and from centers outside the area.

A.5.258. Airport facilities are available in Houma, Monroe, and Morgan City. Numerous smaller airfields and landing strips as well as heliports and seaplane bases are scattered throughout the area. Within commuting distance to the area are the New Orleans International, Baton Rouge, Alexandria, and Lafayette airports.

A.5.259. I-10 crosses the basin in an east-west direction between Baton Rouge and Lafayette. US Highways 90 and 190 also traverse the area in an east-west direction. US Highway 90 connects the major urban coastal centers, including Houma, Morgan City, Franklin, New Iberia, and Lafayette. US Highway 190 crosses the central portion of the area between Baton Rouge and Opelousas.

A.5.260. North-south Federal highways include 71, 165, and 167. US Highway 71 begins at Krotz Springs at about midpoint in the economic area and runs in a northwesterly direction through Alexandria. US Highway 165 connects the towns of Alexandria and Monroe; US Highway 167 runs between Lafayette, Opelousas, and Alexandria, and connects US Highways 90 and 190 and I-10. LA Highway 1 roughly parallels the eastern boundary of the basin study area from Alexandria southeast through Thibodaux to the coast. LA Highway 105 connects US Highway 190 and LA Highway 1 between Krotz Springs and Simmesport. Numerous local roads exist in the economic area, as parish highways follow north-south routes paralleling the Atchafalaya Floodway System or run on top of the floodway protection levees. In the floodway proper, between I-10 and US Highway 90, there are no roadways.

OIL, GAS, AND MINERALS

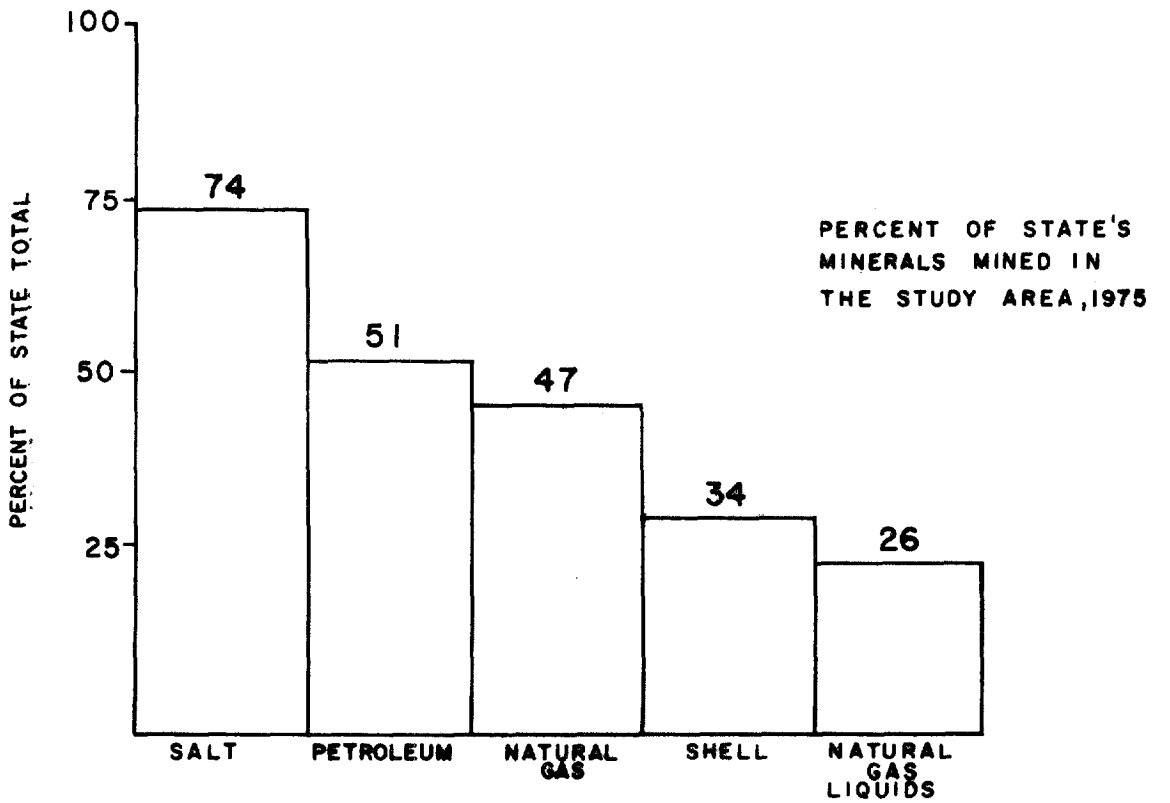
A.5.261. Many factors have led to an increasing demand for the area's mineral resources: the transition of the nation's economy from largely agrarian to highly industrial; the many technical advancements made since the turn of the century and resulting mass production of new products, the revolutionary changes in transportation systems, and the expansion of markets. Minerals produced in the 19-parish economic area include petroleum, natural gas, natural gas liquids, salt, sulfur, sand and gravel, shell, clay, and lime. By-products of the natural gas and shell include carbon black and cement. Petroleum production in Louisiana increased from 104 million barrels in 1940 to 209 million in 1950, to 401 million barrels in 1960 and 907 million in 1970. Its value increased from $107 million in 1940 to $3,062 million in 1970. The "Bureau of Mines Minerals Yearbook for 1976" reports crude petroleum production in Louisiana to have been 607 million barrels valued at $4,557 million.

A.5.262. Natural gas production in the state increased from 343 thousand million cubic feet (MMCF) valued at $64 million in 1940 to 7,007 MMCF valued at $3,223 million in 1976. Oil and gas account for almost 90 percent of the value of the state's mineral production. Table A-5-28 shows the value of production in the economic area for randomly selected years from 1960 to 1970 and for the 6 subsequent years of record. The table also compares data for the economic area with data for the state and nation.

A.5.263. The percentage of the state's minerals that come from the study area is shown by Figure A-5-15. In 1976, the value of mineral production in the area's four coastal parishes alone totaled $3.4 billion or 4.9 percent of the US total. Table A-5-29, shows a further disaggregation of values and the quantities of major minerals and associated raw materials produced in the area.

A.5.264. More than any other single factor, the expansion of mineral production has led to the area's employment, income, and population growth. Only six of Louisiana's 64 parishes have unemployment levels below 6 percent. Five of them are in South Louisiana and three of the five (Iberia, Lafourche, and Terrebonne) are coastal parishes of the Atchafalaya economic area. The 1970 census reported that direct employment in mineral production accounted for 14 percent of the total in coastal parishes and 8 percent in the economic area overall.

A.5.265. In comparison, employment in agriculture, forestry, and fisheries combined also accounted for about 8 percent. From 1949 to 1959 the number of parishes in the area with median family incomes exceeding the state median increased from 1 to 5. Per capita personal income increased from 72 percent of the state figure in 1950 to 90 percent in 1959. Since the late 1950's and early 60's some of the



SOURCE : U.S. DEPT. OF THE INTERIOR, BUREAU OF MINES, "THE MINERAL INDUSTRY OF LOUISIANA 1975", AND UNPUBLISHED DATA.

FIGURE A-5-15 MINERALS

TABLE A-5-28
VALUE OF MINERAL PRODUCTION - ATCHAFALAYA BASIN AREA
(In Thousands)

Area	1960	1965	1969	1970	1971	1972	1973	1974	1975	1976
Assumption	$ 20,165	$ 19,941	$ 28,800	$ 29,651	$ 29,847	$ 30,284	$ 33,245	$ 44,260	$ 51,909	$ 60,032
Avoyelles	1,914	3,660	5,732	4,420	5,810	4,112	3,374	5,536	5,333	5,297
Caldwell	583	2,561	2,516	3,088	3,946	3,345	2,626	1/	1/	1/
Catahoula	5,419	10,377	9,526	10,949	11,309	10,943	8,313	15,640	1/	14,772
Concordia	14,948	18,972	29,216	23,894	1/	21,521	16,379	23,321	22,978	22,964
Franklin	2,627	1,978	2,185	2,108	2,397	2,219	2,278	2,361	2,318	2,309
Iberia	84,715	92,225	235,463	216,385	298,230	311,490	329,511	432,670	469,761	495,556
Iberville	26,992	44,194	60,166	61,881	67,260	61,775	59,521	73,077	70,084	68,397
Lafourche	187,319	309,069	474,939	515,299	470,507	426,523	439,940	582,091	583,386	583,167
LaSalle	17,584	18,532	21,970	25,075	23,840	23,199	22,774	34,770	33,821	33,700
Ouachita	9,423	9,417	20,961	6,461	1/	7,054	7,273	11,146	1/	15,287
Pointe Coupee	7,752	11,422	30,378	31,162	29,427	24,339	22,306	33,706	33,210	32,458
Richland	16,515	15,070	16,819	18,484	22,518	24,597	29,953	47,631	45,968	45,636
St. Landry	40,699	47,433	50,965	48,283	42,582	37,324	43,311	52,705	50,806	51,783
St. Martin	48,468	64,502	89,122	88,187	89,672	79,961	69,312	95,802	97,852	101,246
St. Mary	122,644	234,936	390,233	473,513	536,844	524,946	633,573	961,699	1,016,590	1,045,633
Tensas	15,010	17,405	7,554	8,463	4,202	3,646	3,350	4,712	4,890	5,017
Terrebonne	199,815	366,583	626,619	756,968	874,853	852,821	901,082	1,196,121	1,265,588	1,268,862
West Baton Rouge	1,103	652	4,382	2,603	1/	1/	6,426	8,556	8,117	8,035
TOTAL	$823,695	$1,288,929	$2,107,546	$2,326,874	$(2,513,244)	$(2,450,099)	$2,634,547	$(3,625,804)	($3,762,611)	($3,860,151)
Percent of State Total	41.4	43.1	45.0	45.6	45.3	45.3	45.3	44.5	44.2	44.6
US Total (millions)	$18,032	$21,524	$26,791	$29,791	$30,708	$32,217	$36,788	$55,172	$62,266	$69,178
* Percent of US Total	4.6	6.0	7.8	7.8	8.2	7.6	7.2	6.6	6.0	5.6

1/ - Withheld to avoid disclosure of confidential data of individual companies.

Sources: US Department of Interior, Bureau of Mines, "Bureau of Mines Mineral Yearbook" (preprints) for Louisiana "The Mineral Industry of Louisiana."
* US Department of Commerce, Bureau of the Census, "Statistical Abstract of the United States".

TABLE A-5-29
VALUE AND QUANTITY OF MAJOR MINERALS IN STUDY AREA

	SALT		STONE (SHELL)		PETROLEUM		NATURAL GAS LIQUIDS		NATURAL GAS	
	$1,000 Value	(Thousand, short ton) Product	$1,000 Value	(Thousand, short ton) Product [1]	$1,000 Value	Product [2]	$1,000 Value	Product [2]	$1,000 Value	MMCF Product
1970	55,453	10,740	6,139	4,285	1,455,537	431,165	95,708	41,879	692,410	3,603,122
1971	58,449	10,335	6,335	4,474	1,586,129	441,529	107,808	42,975	783,014	3,876,314
1972	57,342	10,451	5,703	4,483	1,480,597	412,422	108,621	42,762	785,573	3,850,846
1973	54,772	9,811	7,522	5,188	1,546,541	386,448	126,853	42,527	885,768	3,954,316
1974	64,232	10,278	7,198	4,369	2,227,945	341,395	183,678	39,396	1,126,094	3,718,173
1975	64,140	8,952	12,363	3,528	2,135,356	334,077	148,961	34,907	1,415,232	3,345,887
1976	75,582	10,967	[3]	[3]	2,110,028	280,845	118,747	26,192	1,522,033	3,304,906

[1] Production of clays 1970-77 3,691,000 short tons, value $5,511,000.
Production of sand and gravel 1970-76, 10,139,000 short tons, value $18,102,000.
Information on the value and production of carbon black, lime, and sulphur was withheld so as not to reveal individual company data.
[2] Measured in thousand 42-gallon barrels.
[3] - Withheld so as not to disclose individual company data.

Source: US Department of the Interior, Bureau of Mines, unpublished data.

construction associated with mineral production has declined; nevertheless, the 1970 Census indicated that the three parishes producing the greatest quantities of oil and gas (Lafourche, St. Mary, and Terrebonne) also were the three parishes with median family incomes exceeding the state's median family income.

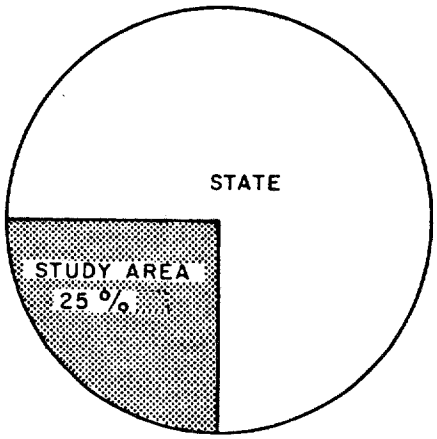
A.5.266. The impacts of expanded mineral production and associated economic growth since the 1950's can be further illustrated by population trends in the coastal parishes. From 1950 to 1960, the population of the area's coastal parishes increased at an annual compound rate of 2.7 percent while the population of the US increased at an annual rate of 1.7 percent. From 1960 to 1970, the population of these parishes increased at an annual rate of 1.9 percent while population increased nationally at a rate of 1.3 percent annually.

TIMBER

A.5.267. Commercial forests comprise a large portion of the study area, almost 40 percent. In fact, 25 percent of the state's commercial forests are located in the study area. Also 51 percent of the bottomland hardwoods in the state are in this area (Figure A-5-16). Although this area abounds in trees, commercial forests are decreasing faster than the state average. During the period 1964-74, commercial forests in the study area decreased 15.7 percent compared with a 9-percent decrease in the state (Table A-5-30). Sixteen of the 19 parishes in the study area had decreases in commercial forest area from 1964 to 1974.

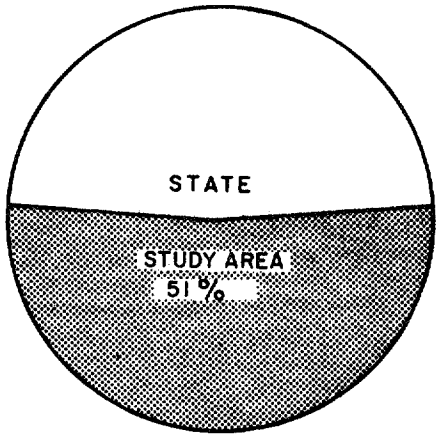
A.5.268. The total stumpage value of severed timber within the study area amounts to only a small portion of the state's total timber value due to the high value and volume of pine produced in other areas. However, the study area accounts for a large portion of the state's hardwoods. Over 70 percent of the cypress and 41 percent of the cottonwood and willow severed in the state come from the study area (Table A-5-31). This area accounted for 35 percent of all hardwood timber severed in the state in 1977 (Figure A-5-17). In 1976 the total stumpage value of severed timber in the economic area was about $13.5 million, or 11.2 percent of the state total, with about 69 percent of this income ascribable to the severence of pine and pulpwood pine (Table A-5-32). About two-thirds of the total study area timber sales occurred in the northern study area parishes of Caldwell, LaSalle, and Ouachita.

COMMERCIAL FORESTS



25 PERCENT OF STATE'S COMMERCIAL FORESTS ARE LOCATED IN THE STUDY AREA, 1974

BOTTOMLAND HARDWOODS



51 PERCENT OF STATE'S BOTTOMLAND HARDWOODS ARE LOCATED IN THE STUDY AREA, 1974

SOURCE: U.S. DEPT. OF AGRICULTURE, "FOREST STATISTICS FOR LOUISIANA PARISHES, 1975."

FIGURE A-5-16 COMMERCIAL FOREST AREAS

TABLE A-5-30

FORESTRY DATA
(In Thousands of Acres)

Parish	Total Area	Commercial Forest Area	Percentage Change 1964-74	Bottomland Hardwoods
Assumption	243.2	138.6	-3%	138.6
Avoyelles	544.0	239.4	-24%	222.3
Caldwell	352.6	284.2	-7%	98.6
Catahoula	480.6	203.0	-41%	119.0
Concordia	480.0	219.3	-30%	219.3
Franklin	414.7	67.1	-53%	54.9
Iberia	414.1	121.9	+6%	121.9
Iberville	411.5	279.3	-1%	279.3
Lafourche	865.9	178.2	+14%	178.2
LaSalle	427.5	357.5	-4%	110.0
Ouachita	411.5	256.2	-15%	109.8
Pointe Coupee	376.3	154.0	-21%	154.0
Richland	369.3	86.9	-42%	86.9
St. Landry	598.4	220.0	-14%	214.5
St. Martin	514.6	305.5	-2%	299.0
St. Mary	453.8	148.5	+4%	148.5
Tensas	413.4	162.0	-30%	162.0
Terrebonne	1,114.3	113.4	-7%	113.4
West Baton Rouge	135.7	62.0	-10%	62.0
Total	9,050.8	3,597.0	-15.7%	2,892.2
State Total	31,059.4	14,526.6	-9%	5,635.5
% of State Total	29.1%	24.8%		51.3%

Source: US Department of Agriculture, "Forest Statistics for Louisiana Parishes, 1975."

TABLE A-5-31

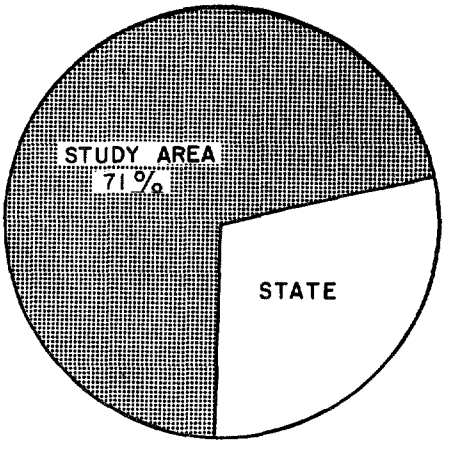
TIMBER SEVERED BY SPECIES AND PARISH (1977)
Board Feet - Doyle Scale

Parish	Hardwood[1/]	Pulpwood Hardwood[2/]	Cypress	Cottonwood and Willow
Assumption	232,309	112.72	12,256	3,040
Avoyelles	3,446,060	16,493.82	152,125	66,204
Caldwell	3,647,201	19,967.23	2,795	27,783
Catahoula	3,078,664	22,449.49	73,390	16,288
Concordia	14,440,334	51,257.46	276,873	788,767
Franklin	1,313,131	3,281.05	15,770	10,196
Iberia	0	61.88	0	0
Iberville	4,380,652	308.23	314,301	703,879
Lafourche	1,095,284	0	426,832	3,947
LaSalle	2,881,267	21,597.83	17,046	416
Ouachita	3,604,113	26,357.40	78,056	338
Pointe Coupee	6,673,557	18,249.59	159,616	296,758
Richland	3,798,477	4,208.31	184,833	7,184
St. Landry	10,095,817	8,243.84	347,139	444,835
St. Martin	204,179	723.12	29,034	189,452
St. Mary	497,338	15.65	0	0
Tensas	15,494,284	61,194.01	321,402	2,149,393
Terrebonne	244,500	0	422,845	0
West Baton Rouge	2,494,415	582.88	22,419	211,223
Total	77,621,582	255,104.51	2,856,732	4,919,703
State Total	221,553,804	731,686.94	4,031,298	12,006,080
Percent of State	35	34.9	70.9	41

[1/] Includes oak, ash, gum, and other hardwoods not including cypress, cottonwood, and willow.
[2/] Measured in standard cords.

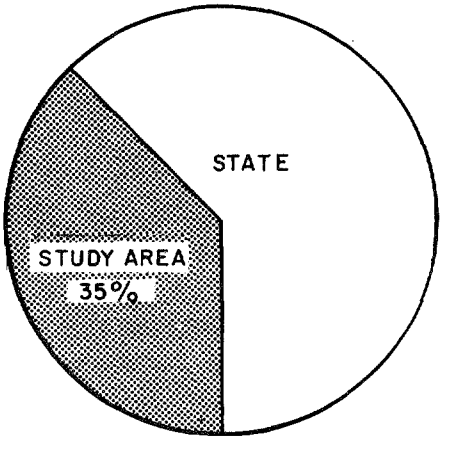
Source: Louisiana Department of Natural Resources, Office of Forestry, "Timber and Pulpwood Production in Louisiana", April 1978.

CYPRESS



71 PERCENT OF CYPRESS TIMBER SEVERED IN THE STATE IS IN STUDY AREA, 1977

HARDWOODS



35 PERCENT OF HARDWOOD TIMBER SEVERED IN THE STATE COMES FROM STUDY AREA, 1977

SOURCE: LOUISIANA DEPT. OF NATURAL RESOURCES, OFFICE OF FORESTRY "TIMBER AND PULPWOOD PRODUCTION IN LOUISIANA", APRIL 1978.

FIGURE A-5-17 CYPRESS AND HARDWOODS

TABLE A-5-32

1976 FORESTRY DATA
(In Dollars)

Parish	Stumpage Value of Severed Timber							
	Total	Cypress	Oak	Ash	Pine	Pine Pulpwood	Gum	Cotton & Willow
Assumption	2,425	8	1,128	3	---	466	667	---
Avoyelles	337,909	6,171	110,483	17,064	22,641	26,790	36,134	7,325
Caldwell	2,820,713	1,252	104,184	251	2,396,960	195,969	17,971	79
Catahoula	996,747	2,281	72,612	19,798	540,868	80,413	29,846	1,232
Concordia	431,945	3,242	114,322	18,126	---	670	27,245	10,002
Franklin	172,126	670	21,718	996	135,382	3,488	1,864	50
Iberia	1,171	---	---	---	---	---	---	---
Iberville	462,084	37,514	71,258	99,256	1,526	56	45,759	89,125
Lafourche	95,184	17,437	17,246	12,261	---	237	41,433	2,155
LaSalle	4,301,278	6,122	90,181	480	3,458,390	628,300	41,798	56
Ouachita	1,729,571	839	87,906	111	1,320,608	231,037	1,695	---
Pointe Coupee	672,677	19,734	133,324	26,758	178,438	33	91,248	41,105
Richland	207,062	1,537	131,159	6,283	12,773	2,583	10,402	197
St. Landry	379,240	16,820	150,012	46,258	---	177	39,823	25,628
St. Martin	86,214	2,092	189	1,338	---	89	11	81,881
St. Mary	83,321	---	153	---	26,408	125	---	---
Tensas	680,134	6,228	185,966	32,262	135	394	111,939	42,686
Terrebonne	5,338	2,301	2,036	156	---	---	845	---
West Baton Rouge	18,526	188	1,633	770	---	37	1,327	362
TOTAL	$13,483,665	$124,436	$1,295,510	$282,271	$8,094,129	$1,170,864	$500,007	$301,883
Percent of State	11.3	68.4	34.0	73.8	9.0	6.5	39.0	51.0
LOUISIANA	$118,950,295	$181,995	$3,810,257	$382,604	$89,987,722	$17,999,839	$1,281,402	$591,858

Source: Louisiana Forestry Commission, "1976 Timber and Pulpwood Production in Louisiana".

INDUSTRY

A.5.269. The manufacturing sector of the economic area has been boosted by the expansion of the petrochemical industry in south Louisiana. Manufacturing employment (Table A-5-33) in the study area in 1954 amounted to 17,317 with an annual payroll of about $50.2 million. Between 1954 and 1977, such employment increased to 34,900, or 101.5 percent, with the annual payroll expanding to $447.5 million, or 791 percent. These growths in employment and annual payroll over the 1954-72 period greatly exceeded comparable statewide figures of 34.2 and 403 percent, respectively.

A.5.270. Value added by manufacture in the study area in 1977 was $1,527.3 million, or 16.1 percent of the statewide total. Important classifications of the manufacturing sector within the economic area include industries associated with the processing of chemicals, including industrial and miscellaneous chemicals and allied products, food and kindred products, sugar, and lumber and wood products. Boat-building facilities, printing and publishing, and the manufacture of transportation equipment are other significant economic factors in this sector.

PARKS AND RECREATION

A.5.271. The Lower Atchafalaya Basin Floodway is largely undeveloped from the standpoint of parks and recreation, but with the advent of a newly found environmental awareness on the national level, people of all ages are being drawn to environmentally unique areas, like the basin, to seek out and enjoy nature's beauty. Also, as previously stated, the mode of existence for basin dwellers has traditionally been based on a livelihood of hunting, fishing, and gathering. These activities have evolved into recreational pursuits that occur today by those who follow their ancestoral tradition of using the swamp's resources--the full potential of which has yet to be realized. Most important of these activities are fishing and hunting, along with crawfishing, camping, boating, swimming, and many others.

A.5.272. Limiting Factors. Recreational use of the Lower Atchafalaya Basin Floodway is limited in scope and intensity because of public access. Although water bottoms and accretion areas are claimed in state ownership, almost all land areas and many water access areas are privately-owned. Some state-owned lands are posted against public use by the adjacent landowners or their leasees. Posting of private lands by owners or lessees has deterred general public use and has severely limited the market potential for public recreational development. In addition, state-claimed land is often posted by adjacent landowners or lessees, compounding the problem of public access.

TABLE A-5-33

MANUFACTURING DATA

Parish	Employment				Annual Payroll ($1000)				Value Added ($1000)			
	1954	1963	1972	1977	1954	1963	1972	1977	1954	1963	1972	1977
Assumption	$ 838	$ 794	$ 700	500	$ 2,376	$ 3,751	$ 5,500	5,500	$ 9,817	$ 16,941	$ 12,200	12,200
Avoyelles	516	295	500	1,100	1,233	1,071	2,700	7,300	2,364	2,994	8,000	21,000
Caldwell	132	117	300	1/	243	308	2,100	1/	375	225	4,500	1/
Catahoula	172	223	1/	1/	353	1/	1/	1/	540	1/	1/	1/
Concordia	196	285	400	1/	391	916	1,800	1/	512	1,520	2,600	1/
Franklin	124	365	500	500	265	1,026	2,200	3,500	725	1,807	3,300	9,300
Iberia	1,043	1,677	2,000	4,000	2,824	6,567	13,100	43,000	5,451	15,597	36,100	94,400
Iberville	631	1,096	2,200	3,500	1,462	6,874	26,400	68,900	2,181	39,894	254,500	634,600
Lafourche	1,584	1,666	2,200	2,600	4,645	7,675	15,900	31,400	6,800	21,174	31,000	73,100
LaSalle	775	623	1,200	1,200	1,912	2,013	7,800	11,100	2,721	4,024	24,400	52,000
Ouachita	5,402	5,723	6,400	7,700	19,951	30,507	57,100	113,000	51,540	65,914	126,500	245,000
Pointe Coupee	352	278	200	1/	717	849	900	1/	1,467	1,634	2,400	1/
Richland	101	248	700	600	238	759	3,600	4,700	446	1,699	6,300	8,300
St. Landry	1,002	878	1,200	1,900	2,434	2,964	7,000	16,600	4,737	7,930	14,500	41,800
St. Martin	368	419	1,200	2,300	910	1,127	5,500	16,500	1,315	3,338	8,500	23,300
St. Mary	1,800	2,030	4,300	5,500	5,490	8,756	37,700	81,200	12,758	30,786	98,700	199,900
Tensas	242	146	1/	1/	569	1/	1/	1/	849	1/	1/	1/
Terrebonne	1,875	1,841	3,700	3,000	3,833	7,384	29,700	38,000	8,218	15,741	59,300	75,800
W. Baton Rouge	164	229	300	500	362	821	2,800	6,800	968	1,984	10,500	36,400
TOTAL	$ 17,317	$ 18,933	$ 28,000	$34,900	$ 50,208	$ 83,368	$221,800	$447,500	$113,784	$233,202	$703,300	$1,527,300
Percent of State	12.0	13.6	15.6	18.0	9.4	10.8	13.8	16.7	9.6	12.2	16.4	16.1
LOUISIANA	$144,757	$139,511	$179,600	$194,200	$531,639	$769,410	$1,602,300	$2,673,700	$1,181,649	$1,915,625	$4,282,400	$9,503,100

1/ withheld to avoid disclosure of information.

Source: US Department of Commerce, Bureau of the Census, "Census of Business, Manufacturing, Louisiana", 1958, 1963, 1972, 1977.

A.5.273. The Lower Atchafalaya Basin Floodway, contains large rivers, lakes, bayous, swamps, and bottomland hardwood forests, and experiences seasonal inundation of varying stages. Recreation development that has occurred in the northern portion of the floodway around I-10 is not large in scale and is subject to periodic flooding.

A.5.274. Private ownership and the flooding of large areas have limited the use and access within the basin. Major east-west highways, including I-10, US Highways 190 and 90, cross the basin at its northern and southern extremities and offer limited access. Parish highways follow north-south routes paralleling the basin or running on top of the floodway protection levees. Interior access in the basin is primarily by boat, with interior land access to the public occurring in very few places.

A.5.275. Mineral extraction within the floodway is not a major impediment to recreation, since it does provide some access; however, it also deters some uses within the basin. Channelizing for operational access alters natural flow patterns and sedimentation rates; pipelines and storage tanks present obstacles to some uses, and visual and audio esthetics are often destroyed. Mineral extraction is a disruptive factor to the recreational attractiveness of the basin in areas where it is concentrated.

A.5.276. Trapping, commercial fishing, crawfishing, and timber harvestings are not considered as direct threats to potential recreational uses, but do compete for the same resources upon which current recreational pursuits depend. Habitat destruction, caused by agricultural land clearing and clearcut timber harvests, is a threat to hunting and fishing resources. These land-clearing practices reduce the existing resource base and degrade water quality, thereby decreasing associated recreational values. However, cleared lands would offer potential for some forms of recreation not now common to the basin, such as upland game hunting.

A.5.277. The existing physical condition of the basin offers an extensive array of recreational use potential from a nondevelopmental standpoint. Limiting this potential is the lack of adequate secondary support facilities which must be present to accommodate wider usage patterns. The result is that existing use occurs in one of two ways.First, either the individual user is a member of a family group or private club, using its clubhouse or camp as the support facility or is one who engages in day-use activities only. Many private club users are local residents of the area and for them the club is a retreat affording a degree of exclusivity. The second type of use is by the day-user (normally fishermen) who, by virtue of the time/distance allocation, is also a resident of the local area. These use patterns, as indicated in the "1971-1974 Atchafalaya Basin Usage Study," do impact the basin by shrinking the potential market area of the Lower Atchafalaya Basin Floodway and placing a heavy reliance on local populations for the majority of recreation use.

A.5.278. In the "1971-1974 Atchafalaya Basin Usage Study," prepared cooperatively by the US Army Corps of Engineers, New Orleans, and the Louisiana Department of Wildlife and Fisheries, responses indicated that 50 percent of all users came from within a 25-mile radius and 90 percent within a 50-mile radius. The average round-trip distance traveled was 62 miles. These responses identified the majority of existing users as individuals who, by residing and/or working in or close to the Atchafalaya Basin, have acquired the means to access and use the basin for recreational purposes.

A.5.279. Existing Recreation Inventory. The existing recreation lands and facilities located in or near the Atchafalaya Basin can be categorized into two groups: public use, which includes commercial establishments that serve the public on a fee basis, and private exclusive use.

A.5.280. Boat launching ramps are the most numerous public facilities in terms of recreational development (Figure A-5-18). Public ramps are constructed of gravel, shell, or concrete and are often adjoined by parking lots of variable sizes. These public ramps are usually maintained either by the Louisiana Department of Wildlife and Fisheries or by the local parish. Many of the existing ramps, however, are not routinely maintained, and are in only fair to poor condition. There is no fee for parking or launching at the public ramps.

A.5.281. Many of the commercial ramp operations, in addition to having boat launching facilities, provide such amenities as bait and fishing tackle, guide service, and groceries. Usually there is a nominal cost for parking and/or launching. Most commercial-type ramps are constructed of concrete and provide a courtesy pier or dock to aid in launching.

A.5.282. Both public and commercial-type boat ramps are interspersed primarily along the floodway's periphery or in the vicinity of Butte LaRose. A listing of these ramps showing location, water access, number of lanes, condition, and available parking is shown in Table A-5-34.

A.5.283. There are several commercially-operated campgrounds located in or near the floodway. They generally offer developed camp sites having electrical and water hookups and sanitary facilities. Campgrounds within the floodway are located at Butte LaRose near I-10, at Butte LaRose Bay, at Highway 190 North Service Road near Bayou Courtableau, and at Big Alabama Bayou. These campgrounds have 140 sites, 10 sites, 50 sites, and 28 sites, respectively. Campgrounds outside the Lower Atchafalaya Basin Floodway that influence use in the floodway are located at Port Barre, Morgan City, and East Lake Dauterive, and have 28, 20, and 15 sites, respectively. There are no publicly-owned and operated campgrounds within the basin at the present time.

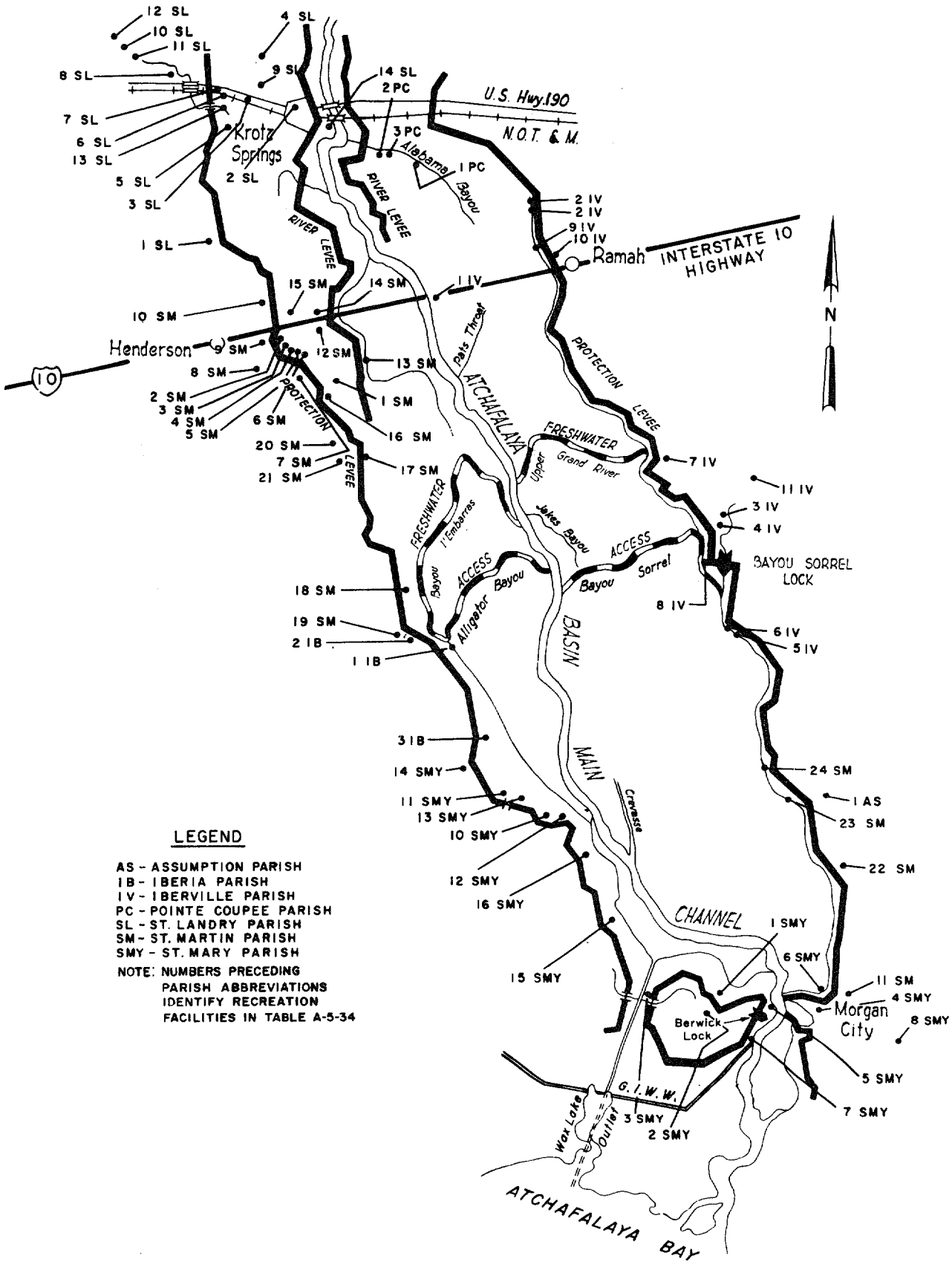


FIGURE A-5-18 EXISTING RECREATIONAL FACILITIES

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
Whiskey Bay Pilot Channel	1 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	3	Concrete/ Excellent	Whiskey Bay/ Inside Levee	50	Asphalt
Borrow Pit - Power Lines Power Lines	2 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	2	Shell/ Fair	Borrow Pit/ Inside Levee	30	Shell/Grass
Bayou Plaquemine	3 IV	Iberville	Commercial	Boat Access	East of Atchafalaya River Channel	1	Shell/ Good	Bayou Plaquemine/ Outside Levee	5	Grass
Bayou Plaquemine	4 IV	Iberville	Commercial	Boat Access	East of Atchafalaya River Channel	1	Shell/ Good	Bayou Plaquemine/ Outside Levee	6	Grass
Bayou Pigeon	5 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	3	Shell/ Very Good	GIWW/ Inside Levee	40	Shell
Bayou Pigeon	6 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Very Good	GIWW/ Inside Levee	50	Grass/Shell
Grand River	7 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	1	Shell/ Fair	Grand River/ Outside Levee	50	Shell
Bayou Sorrel	8 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Good	Bayou Sorrel/ Inside Levee	60	Shell
Borrow Pit Above Ramah	9 IV	Iberville	Commercial	Boat Access	East of Atchafalaya River Channel	1	Shell/ Fair	Borrow Pit/ Inside Levee	20	Grass
Ramah	10 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	1	Dirt/ Poor	Borrow Pit/ Inside Levee	20	Dirt
Jack Miller's	11 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	10	Gravel/ Poor	Bayou Plaquemine/ Outside Levee	10	Gravel
Bayou Peyronnet	1 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Poor	Borrow Pit/ Outside Levee	8	Shell
Brushy Bayou	2 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Dirt/ Poor	Borrow Pit/ Above Hwy. 190 Inside Levee	8	Grass/Shell
Nall's Landing	3 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Good	2 O'Clock Bayou/ Inside Levee	20	Grass/Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
D'Arbonne Bay at Hwy. 71	4 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Poor	Brushy Bayou/ Inside Levee	7	Shell/Grass
Earl's Landing	5 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	2	Shell/ Fair	Bayou Courtableau Drainage Structure/ Inside Levee	5	Shell
RR Bridge and Hwy. 190	6 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	2	Gravel/ Fair	Bayou Courtableau/ Inside Levee	15	Gravel
Hwy. 190 South Under Bridge	7 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Bayou Courtableau/ Inside Levee	15	Shell
Jim's Landing on Hwy. 190	8 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	1	Gravel/ Fair	Bayou Courtableau/ Outside Levee	10	Shell
Atchafalaya Basin Wilderness Camp	9 SL	St. Landry	Commercial	50-unit Campground 5 Picnic Areas	West of Atchafalaya River Channel	1	Shell/ Fair	Borrow Pit/ Inside Levee	10	Grass/Shell
Port Barre Landing	10 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Bayou Courtableau/ Outside Levee	20	Shell/Grass
Veteran Memorial Park	11 SL	St. Landry	Public	3 Picnic Areas, 2 Tennis Courts, 1 Basketball Court, 1 Playground, 1 Playfield	West of Atchafalaya River Channel	--	--------	--------	--	--------
Birthplace of Teche Campground	12 SL	St. Landry	Commercial	28-unit Campground	West of Atchafalaya River Channel	--	--------	--------	--	--------
Jim's Landing	13 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	2	Shell/ Fair	Borrow Pit/ Inside Levee	15	Gravel
Atchafalaya River at Krotz Springs	14 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Good	Atchafalaya River/ Inside Levee	20	Shell/Grass
Aunt Jane's Place	1 SMY	St. Mary	Commercial	Boat Access	Southwest of Atchafalaya River Channel	1	Shell/ Fair	Lower Atchafalaya River/Inside Levee	15	Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
St. Mary Parish	2 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	2	Concrete/ Good	Bayou Teche/ Outside Levee	10	Shell
Wax Lake Outlet	3 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	1	Concrete/ Very Good	Wax Lake/ Inside Levee	50	Grass
Lake End Park	4 SMY	St. Mary	Public	20-unit Campground 10 Picnic Sites	East of Atchafalaya River Channel	5	Concrete/ Very Good	Lake Palourde/ Outside Levee	15	Shell
Casso's Landing	5 SMY	St. Mary	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Good	Atchafalaya River/ Inside Levee	10	Shell
Joe Russo Memorial Landing	6 SMY	St. Mary	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	GIWW/ Inside Levee	65	Shell
St. Mary Parish	7 SMY	St. Mary	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	GIWW-Lower Atchafalaya River/ Inside Levee	100	Grass/Shell
Marcell Memorial Landing	8 SMY	St. Mary	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	Bayou Boeuf-GIWW/ Inside Levee	60	Gravel/Grass
West of Myette Point	10 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	4	Concrete/ Good	Grand Lake/ Inside Levee	20	Grass
Charenton Structure	11 SMY	St. Mary	Public	Boat Access	West of Atchafalaya River Channel	4	Shell/ Fair	Grand Lake/ Inside Levee	6	Shell
Myette Point #2	12 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	1	Shell/ Fair	Grand Lake/ Inside Levee	5	Shell
F.C. Viguerie	13 SMY	St. Mary	Commercial	Boat Access	West of Atchafalaya River Channel	12	Shell/ Fair	Grand Lake/ Inside Levee	40	Grass/Shell
Grand Avoille Cove	14 SMY	St. Mary	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Fair	Grand Avoille Cove/Outside Levee	20	Grass
Verdonville	15 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	1	Concrete/ Good	Grand Lake/ Inside Levee	15	Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
Miller Point	16 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	2	Dirt/ Poor	Grand Lake/ Inside Levee	8	Gravel
Fish Island	1 IB	Iberia	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Fausse Point Cut/Inside Levee	40	Shell
Sand Bar Park/ Fausse Point Recreation Area	2 IB	Iberia	Public	Park, Camping, Picnicking	West of Atchafalaya River Channel	1	Shell/ Good	Lake Fausse Point/ Outside Levee	20	Shell
South Little Lake Long	3 IB	Iberia	Public	Boat Access	West of Atchafalaya River Channel	3	Concrete/ Good	South Little Lake Long/Inside Levee	30	Grass/Shell
Lake Verret	1 AS	Assumption	Public	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Very Good	Lake Verret/ Outside Levee	35	Shell
Big Alabama Campground	1 PC	Pointe Coupee	Commercial	28-unit Campground with water, electricity, and sewage	East of Atchafalaya River Channel	2	Concrete/ Good	Big Alabama Bayou/Inside Levee	25	Grass
Jim's Boat Landing	2 PC	Pointe Coupee	Commercial	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Good	Big Alabama Bayou-Little Alabama Bayou/Inside Levee	30	Shell
Uncle Dick Davis Park	1 SM	St. Martin	Commercial	Boat Access Park, 10-unit Campground	West of Atchafalaya River Channel	1	Shell/ Fair	Butte LaRose Bay/ Inside Levee	5	Grass/Shell
Wiltz Landing	2 SM	St. Martin	Commercial	Boat Access Bait Shop Boat Rental	West of Atchafalaya River Channel	3	Concrete/ Very Good	Henderson Lake/ Inside Levee	20	Shell/Grass
Pat's Landing	3 SM	St. Martin	Commercial	Boat Access Bait Shop Boat Rental	West of Atchafalaya River Channel	2	Concrete/ Good	Henderson Lake/ Inside Levee	20	Gravel
Atchafalaya Basin Landing	4 SM	St. Martin	Commercial	Boat Access Bait Shop Boat Rental	West of Atchafalaya River Channel	3	Concrete/ Good	Henderson Lake/ Inside Levee	30	Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
McGee's Landing	5 SM	St. Martin	Commercial	Bait Shop Boat Rental Tours	West of Atchafalaya River Channel	2	Concrete/ Good	Henderson Lake/ Inside Levee	25	Gravel/Grass
G&L Landing	6 SM	St. Martin	Public	Abandoned Boat Access	West of Atchafalaya River Channel	1	Concrete/ Fair	Henderson Lake/ Inside Levee	10	Shell/Grass
CAP Hedges Landing	7 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Fair	Bayou Berard/ Outside Levee	20	Grass/Shell
Henry Guidry Memorial Park	8 SM	St. Martin	Public	Day Use Park	West of Atchafalaya River Channel	--	-----	--------	--	--------
Tom Huval Landing	9 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Very Good	Bayou Peyronnet/ Outside Levee	15	Gravel
Bayou Peyronnet	10 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Poor	Bayou Peyronnet/ Outside Levee	4	Shell
Brownell Memorial Park	11 SM	St. Martin	Public	9.5-acre Memorial Park and Nature Trail	East of Atchafalaya River Channel	--	-----	--------	--	--------
Frenchman's Wilderness	12 SM	St. Martin	Commercial	140-unit Campground	West of Atchafalaya River Channel	--	-----	--------	--	--------
Butte LaRose	13 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Upper Grand River/Inside Levee	40	Shell
I-10 Rest Stop	14 SM	St. Martin	Public	Rest Stop Picnic Area	West of Atchafalaya River Channel	--	-----	--------	--	--------
Pelba	15 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	3	Concrete/ Excellent	Lake Bigeux/ Inside Levee	50	Asphalt
Gaging Station	16 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Fair	Borrow Pit/ Inside Levee	20	Gravel
Borrow Pit near Bayou Mercier	17 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Very Good	Crocodile Bayou/ Inside Levee	20	Grass/Shell
Bayou Benoit	18 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Very Good	Bayou Benoit/ Inside Levee	40	Grass/Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
Lake Dauterive	19 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Very Good	Dauterive Lake/ Outside Levee	8	Shell
St. Martin Parish Ward 3	20 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/Concrete/Good	Bayou Mercier/ Outside Levee	20	Grass/Shell
Clayton Boudreaux Memorial Park	21 SM	St. Martin	Public	Day Use Park and Picnic Area	West of Atchafalaya River Channel	--	-----	--------	--	--------
Adam's Landing	22 SM	St. Martin	Commercial	Boat Access	East of Atchafalaya River Channel	2	Shell/ Fair	Belle River/ Outside Levee	20	Shell
Belle River Bridge	23 SM	St. Martin	Public	Boat Access	East of Atchafalaya River Channel	3	Shell/ Fair	GIWW/ Inside Levee	10	Shell
Belle River	24 SM	St. Martin	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	GIWW/ Inside Levee	10	Shell

A.5.284. Only a few locally established day-use parks presently exist near the basin. These are found in the communities of Port Barre, Henderson, and Catahoula. The parks generally provide picnic shelters, multipurpose playfields and courts, and playgrounds which sustain a variety of day-use activities.

A.5.285. A state-operated public rest stop and picnic area located at the I-10/Butte LaRose interchange provides two restrooms, 50 picnic tables, and 35 picnic shelters equipped with barbecue braziers.

A.5.286. The Original Swamp Gardens of Morgan City offer an interpretive presentation of the great Atchafalaya Basin swampland. Although this combination living museum and park encompasses only 3.5 acres, it tells a large-scale story of the people who have historically made the swamp their home. The park is highlighted by replicas of swamp-dwellers engaged in traditional activities, as well as live exhibits of native flora and fauna displayed in their natural environment.

A.5.287. Situated just outside the floodway on the west side of Lake Palourde is the Brownell Memorial Park. This scenic park of 9.5 acres is open to the public and, along with its Carillon Tower, provides a nature trail characterized by many varieties of native flora.

A.5.288. The State of Louisiana has diverse land holdings within or near the basin which are recreational in nature. The Attakapas Wildlife Management Area, the center of which is located 20 miles northwest of Morgan City, encompasses 25,500 acres and is accessible only by boat. Future plans include a headquarters building and boat landing to be built adjacent to the West Atchafalaya Basin Protection Levee about 8 miles northeast of Franklin. The Atchafalaya Delta Wildlife Management Area is comprised of some 125,000 acres of accreting delta located at the mouth of the Atchafalaya River in St. Mary Parish. Approximately 25,000 acres of this delta area are above the water surface. Three other state wildlife management areas are located in the market area within Avoyelles Parish. Grassy Lake encompasses 12,500 acres, Pomme de Terre has 4,591 acres, and Spring Bayou totals 11,237 acres. Each of these areas has at least one primitive camping area available for public use. Thisthlethwaite Wildlife Management Area, located in St. Landry Parish, provides 11,100 acres for hunting. No camping is available, but nonhunting activities include nature walks and nature photography. All of these areas are under the jurisdiction of the Louisiana Department of Wildlife and Fisheries and are primarily used for public hunting and/or fishing.

A.5.289. The State Lands Division, Department of Natural Resources, administers a campsite leasing program which includes 218 sites averaging one-half acre in size situated on 11,833 acres in or near the basin. These sites are leased or available for lease by the general public on a bid basis for periods of 10 years. In addition,

any lands in the basin under the jurisdiction of the State Lands Division and undivided under the Campsite Leasing Program remain open to public use.

A.5.290. The Louisiana Office of State Parks, Department of Culture, Recreation and Tourism, has several projects in different stages of development that are located close to the Atchafalaya Basin. Eight thousand acres of land have been acquired for the development of Lake Fausse Point State Park, located just outside of the West Atchafalaya Basin Protection Levee at Lake Fausse Point in Old Bird Island Chute. Initial development, which will occupy 150 acres, consists of building an access road, bridge crossing, clearing and grubbing 75 camping spurs, and constructing eight cabins, each having an occupancy of six. A boat-launching ramp into Bird Island Chute on Lake Fausse Point will be constructed, as well as two large picnic pavillions. When this park is completed, the bulk of the total acreage will be undeveloped and managed as a wildlife preserve.

A.5.291. The Atchafalaya Wilderness Center, when developed, will be classified as a State Preservation Area that offers environmental interpretation, outdoor education, and passive recreation. This center, which will be located just southeast of Catahoula and adjacent to the West Atchafalaya Basin Protection Levee, will be sited on a 450-acre tract of land, of which 400 acres have already been acquired by the state. Bayou Berard flows to the west of the site, providing a water linkage to Lake Dauterive to the south. The interpretive theme of the wilderness center will focus on Acadian culture and the relationship of its evolution to that of the basin. The site was selected for development because of the existing indigenous flora and fauna which characterize the early basin, and also because of the ready accessibility of the basin to the visiting public. A scheduled completion date for the center has not been determined.

A.5.292. Another facility under construction by the Office of State Parks is an interpretive center located at the Plaquemine locks on the Mississippi River. An amphitheater and a tower overlooking the site are planned. The center's interpretive theme will address the historical role of the locks, which date back to the early 1900's, and their relationship to the Mississippi River and Atchafalaya Basin. Initial development is scheduled for completion in 1981.

A.5.293. Two other state parks and one state monument are located in the market area but are somewhat remote from the floodway. Chicot State Park, located 10 miles north of Ville Platte, Louisiana, contains about 6,840 acres. Lake Chicot includes 2,500 acres and is the focal point of recreation. Noted for its scenic beauty, the park is developed for tent and trailer camping along the lakeshore. Trails provide hiking opportunities for nature observers and a 300-acre arboretum is located on the park grounds. Chicot State Park receives heavy use and offers potential for further development for camping, picnicking, fishing, and other outdoor recreational activities.

A.5.294. Longfellow-Evangeline State Park is located in St. Martin Parish on the banks of Bayou Teche in the town of St. Martinville, Louisiana. Development at the park consists of an Acadian House Museum, picnic shelters and tables, and camping facilities. The park lodge is operated as a restaurant. This heavily used park attracts visitors nationwide.

A.5.295. Edward Douglas White Memorial State Monument is located 4 miles north of Thibodaux, Louisiana, off Louisiana Highway 1. The raised cottage, now well over 100 years old, has been restored and contains some of its original furniture.

A.5.296. Other recreation development in the natural basin below the latitude of Simmesport consists primarily of boat-launching ramps and private hunting and fishing camps located along bayous, lakes, and rivers, as well as the Lower Atchafalaya Basin Floodway. Picnic facilities or small day-use parks are scattered in and around towns and municipalities.

A.5.297. Of the 595,000 acres which lie within the study area below US Highway 190, approximately 80 percent is privately-owned. It has been estimated that more than 250 private hunting clubs, many having their own permanent camps, are located in this portion of the basin, predominately in the north. In addition, many privately-owned residential-type camps and houseboats are scattered throughout the basin and are used by their owners or occupants for weekend outings.

A.5.298. Present Recreational-Use Patterns. The Lower Atchafalaya Basin Floodway contains an abundant supply of natural resources. It is this mix of resource types that supports such a diverse potential for recreational use of land and water within the floodway's limits.

A.5.299. Because of higher land elevations in the upper portion of the basin, recreational facilities development, although minimal, is more extensive than those in the lower portions where access is limited and the wetter terrain of swamps and marshlands hinder development. It is this northern portion that attracts the greatest amount of use associated with sport hunting, one of the most actively pursued recreational activities in the study area. Most big game hunting is permitted exclusively by hunting lease. Hunting clubs have their own permanent camps, the use of private posted hunting land, and limited memberships. It is estimated that there were over 250 active hunting leases in the basin in 1980. These clubs are generally located in areas wherever suitable white-tailed deer habitat occurs. White-tailed deer is the main big game species hunted. Black bear hunting, in the area of Lottie between I-10 and LA 10, is limited to the harvest of one bear per day, one bear per season. A turkey flock has been established in the same general area in the upper basin, with a 37-day season already established. The limit is one gobbler per day, three per season. Small game hunting occurs in many of the same

areas as big game hunting. In addition, public lands at various locations within the floodway provide for public hunting of small game, especially rabbits. Some dove hunting occurs over cultivated fields in the northern portion of the basin and squirrels are fairly abundant.

A.5.300. Hunting of migratory gamebirds is an equally important recreational pursuit that occurs in many areas of the basin, as well as in the delta region. These areas of high-quality habitat lie within the Mississippi Flyway and provide some of the best duck hunting in the United States. The Atchafalaya Delta Wildlife Management Area is state-owned and available for public use. Bottomland hardwood stands provide prime habitat for woodcock that winter in the basin. American woodcock hunting is a specialized type hunting; however, many are killed incidental to participation in other types of hunting.

A.5.301. Fishing is probably the most important water-based recreational activity in the Atchafalaya Basin. Wherever there is ample water, fishing is evident; but certain areas do have a higher use because of quality habitat or ease of access. Organized tournament bass fishing has grown in popularity in recent years. As many as 10 different bass clubs and organizations, such as the Lions Club and Kiwanis Club from the Lafayette area, hold tournaments and fishing rodeos out of the Old McGee's Landing on Henderson Lake. Clubs from Houma and Thibodaux fish in a similar manner in the southernmost part of the basin. Within the last couple of years, the basin has supported a national bass fishing tournament sponsored by Bass Masters, Inc. Some of the more noteworthy boat fishing areas are located at Henderson Lake, Cow Island Lake, Lost Lake, Warner Lake, Buffalo Cove, and the Upper Grand River flats. However, not much sport fishing occurs in the river. Several lakes located on the basin's periphery, such as Lake Fausse Point, Lake Palourde, Lake Dauterive, and Lake Verret, offer clear water and good fishing.

A.5.302. Most bank fishing occurs along the borrow pits that line the protection levees on either side of the basin. Much of this land, however, is privately-owned and posted against public use. Some of the areas that most heavily support bank fishing are along US Highway 190's south service road, the pontoon bridge near Butte LaRose ridge, areas along either side of the levee north of Ramah, and areas adjacent to most boat ramps. Both boat and bank fishing activities occur year-round in the basin, with weekend use being the heaviest.

A.5.303. Noncommercial crawfishing is classified as a consumptive recreational pursuit. As opposed to commercial and some sport crawfishing, which is accomplished by boat in the basin's interior, most sport crawfishing is pursued along the floodway levee system, accessible by vehicle. Access to the water, however, is a problem in some areas because of private, posted land. The areas where public

crawfishing is concentrated are the Henderson to Catahoula levee, the south side of Butte LaRose ridge, the river levee south of I-10, and near Morgan City and Ramah. Crawfishing occurs from February through May in these areas provided that water levels are high enough to sustain it. Many families engage in this activity, mostly on weekends, and its popularity is growing.

A.5.304. Frogging is another water-based consumptive recreational activity that is actively pursued in basin-wide. It is not as intensive a use as fishing or crawfishing, but a genuine interest is reflected in it by advocates of the sport. Frogging occurs generally in the summer months, usually in cypress-tupelo back swamps. It generally occurs at night, and most participants are local people who know their way around the basin. Bullfrogs are sought throughout the area and pigfrogs are sought in the coastal areas.

A.5.305. There are areas in and around the basin which support sport crabbing. In many instances, sport fishermen will throw out crab nets while they fish, but experienced individuals who want to crab specifically concentrate their efforts at Charenton, Lake Dauterive, and areas south of Morgan City. This activity occurs mostly in the summer season and results in the catching of the blue crab.

A.5.306. There are many water-based nonconsumptive type recreational activities that are being pursued with greater intensity and frequency in the Atchafalaya Basin. This has been caused partly by a renewed public awareness and interest in the environment during the last decade, and the relative economy of engaging in nature study and appreciation as opposed to absorbing consumptive recreational costs. The size and environmental diversity of the basin offer many opportunities for such recreational pursuits.

A.5.307. Canoeing is becoming quite popular in the basin. Two commercial operations in Lafayette and two in New Orleans offer nationally-advertised guided canoe sorties into the basin. Additionally, local environmental groups sponsor canoe trips several times each year. Canoeists usually seek out fairly accessible bayous that flow through scenic swamps of cypress and tupelo. These areas are found at Henderson Lake, Beau Bayou, Bayous Pigeon and Sorrel, the Flats, and Upper Grand River. Canoeing in these areas provides ample opportunity for viewing the natural flora and fauna. With this in mind, most canoeing occurs in the spring and fall when biting insects and hot, humid weather are less intense, but when vegetation is full and more wildlife can be observed.

A.5.308. Some sightseeing tours of the basin are sponsored by local Lafayette hotels in conjunction with the Council for the Development of French in Louisiana, and by commercially-operated tour services in the Henderson Lake area. Pontoon boats or fiberglass hulled boats are used from spring through fall to shuttle small groups of tourists,

many of French nationality, on tours into the basin. As a result, visitors can gain first-hand experience of the basin's swamp environment and perhaps realize the basin's influence on the evolution of the Acadian culture.

A.5.309. Birdwatching, wildlife observation, and nature photography are compatible activities that occur within the basin, often during canoe trips or during guided tours. Although there are concentrations of certain wildlife species in different areas of the basin, such as aquatic birds, alligators, and bears, the basin as a whole offers a wide diversity of flora and fauna that can be easily observed by the nature enthusiast.

A.5.310. Bayou Penchant has been classified as a natural and scenic stream by the State of Louisiana, Department of Wildlife and Fisheries. It is located in the southern part of the basin in Terrebonne Parish and is free flowing and unaltered. Its banks are covered with native vegetation. Areas such as this provide the opportunity for nature study and general enjoyment.

A.5.311. Numerous bird rookeries have been identified in the basin and the breeding bird population occupying them has been estimated at 20,000 plus. In the coastal marshes, the presence of wintering migratory waterfowl and bald eagles, along with the other bird species, provide rewarding birdwatching activities.

A.5.312. Other water-oriented sports, which have attained some degree of participation by basin-goers, are waterskiing and swimming. These are summer activities that occur mostly on weekends. Waterskiers are usually found at Henderson Lake, Bayou Courtableau, and Butte LaRose canal. Those lakes just outside the floodway, such as Lake Verret and Lake Palourde, are heavily used by waterskiers. Swimming is incidental to most other water-oriented activities, as there are no designated swimming areas in the basin at present. Some swimming, however, near launch sites does occur.

A.5.313. Nonconsumptive land-based recreational activities are not as intensely pursued within the basin, since access and the private ownership of land inhibit use by the general public. Yet the potential for expanding recreational use is ever present. Even with existing constraints, some recreational opportunity is afforded the public for use of parts of the floodway and levee system. Sightseeing, driving for pleasure, walking, hiking, and bicycling are all activities that occur generally on the levee roads that outline the floodway. These activities are not heavily concentrated but do occur closer to populated areas. Jogging and running have increased in popularity in recent years and levee roads generally serve as suitable jogging paths. The Acadian Running Club from Lafayette, Louisiana, sponsors an annual event, the Great Atchafalaya Road Race, which follows the levee course from Catahoula to Henderson, a distance of

11 miles. Levees are used on occasion for other activities, such as horseback riding and all-terrain vehicle trails, as well as providing sites for an occasional fish fry or crawfish boil.

A.5.314. As previously noted, most camping is done on private lands in conjunction with hunting. There are also private residential camps established in the basin as "weekend hideaways". These are concentrated in such areas as Henderson, Butte LaRose Bay, Bayou Chene, Alabama Bayou, Bayou des Glaises, and Bayou Courtableau. A flotilla of private houseboats that serve as camps is located in the Cocodrie area. Only a few commercially-operated public campgrounds are located in or near the basin floodway. They are used most heavily during the summer.

A.5.315. Other public camping occurs in very primitive areas on the elevated banks along the basin's interior waterways, and in wildlife management areas during hunting season. The Atchafalaya Delta Wildlife Management Area has designated certain sites as primitive camping areas, used mostly by hunters.

A.5.316. Most land-based nature study occurs adjacent to the levees at the land-water interface and on public lands. Although there is a potential for additional environmental interpretation areas near or in the basin, several existing interpretive facilities provide for public awareness of the project-related environment. Brownell's Memorial Park and the Original Swamp Gardens, both located near Morgan City, draw many local and distant visitors because of their basin-related attractions, such as native flora and fauna, history, and Acadian culture. In addition, many local communities sponsor their own cultural and heritage festivals that relate to the overall influence of the Atchafalaya Basin. Breaux Bridge has its annual Crawfish Festival, New Iberia hosts the Sugar Cane Festival, and Lafayette stages its Festival Acadien, to name a few. As many as 50,000 people are often attracted to these festivals where eating, drinking, dancing, and celebrating is the order of the day, and people enjoy numerous fun-filled activities related to the traditions and culture of the area.

A.5.317. The Atchafalaya Basin in its diversity has become a focal point for existing regional recreational opportunity and offers future potential. The fact that it is the nation's largest remaining bottomland hardwood swamp-river overflow ecosystem, has one of the few active river deltas in the world, provides the largest commercial crawfish catch in the world, and today may harbor the last of the ivory-billed woodpeckers, adds to its attraction base.

FISHING, HUNTING, AND TRAPPING (COMMERCIAL ASPECTS)

A.5.318. The waterways and wetlands of the Atchafalaya Basin area have generated and support a thriving commercial fishing industry. In the Atchafalaya Basin, crawfish, buffalo, and catfish comprise the species of major importance in terms of pounds and value. Table A-5-35 shows the catch and value over the 1976-1979 period. Crawfish, buffalo, and catfish accounted for over 92 percent of the value of the catch from the basin during 1979.

A.5.319. Trapping makes a substantial contribution to the Louisiana economy, amounting to millions of dollars. Trapping's contribution to the state economy, as well as the contribution of the Atchafalaya Basin for three selected species, is presented in Table A-5-36. Table A-5-37 demonstrates the overwhelming importance, in the Atchafalaya Basin, of the three species presented in Table A-5-36. By this estimate, they account for approximately 96 percent of the value of trapping during each of the three years. Table A-5-38 presents the most recent data on numbers and value of the three dominant Atchafalaya Basin species.

TABLE A-5-35

COMMERCIAL ASPECTS OF FISH AND SHELLFISH

Species	1976 Pounds	1976 Value $	1977 Pounds	1977 Value $	1978 Pounds	1978 Value $	1979 1/ Pounds	1979 1/ Value $
BOWFIN	13,200	945	11,500	1,014	3,700	356	13,600	1,406
BUFFALO	726,900	108,587	836,200	129,733	1,365,700	231,959	2,055,400	353,113
CARP	105,100	4,272	59,800	2,959	61,500	3,235	131,800	10,128
CATFISH	644,600	225,585	631,900	228,216	660,400	270,170	613,600	255,509
GARFISH	75,900	11,029	93,700	15,996	130,500	25,375	158,500	34,280
PADDLEFISH	3,100	249	2,700	254	14,900	1,759	30,600	3,349
FRESHWATER DRUM	354,300	52,582	345,500	52,448	203,900	32,307	527,600	87,068
SHAD	573,100	21,735	654,600	31,039	413,100	25,644	474,100	48,343
CRAWFISH	5,620,100	1,692,063	1,310,900	708,413	13,941,700	4,107,092	5,524,500	1,981,940
FW TURTLE	9,100	4,013	6,900	3,247	13,400	5,016	29,900	16,249
FROG	25,000	19,075	21,000	19,969	33,500	47,492	15,400	15,166
RIVER SHRIMP	2,500	1,750	2,000	1,392	4,800	3,663	8,500	6,376
TOTAL	8,152,900	2,141,885	3,976,700	1,194,680	16,847,100	4,754,068	9,583,500	2,812,927

1/ Preliminary, subject to revision

Source: National Marine Fisheries Service as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin", F. W. Bell, 1981.

TABLE A-5-36
COMPARATIVE ANALYSIS: LOUISIANA VERSUS ATCHAFALAYA RIVER BASIN IN FUR HARVEST

Species	Louisiana	Atchafalaya	Percent of State
Nutria		Number	
1971-72	1,286,622	9,000	0.7
1972-73	1,611,623	42,000	2.6
1973-74	1,749,670	30,000	1.7
		Value ($)	
1971-72	4,146,488	24,000	
1972-73	6,737,774	136,000	2.0
1973-74	8,998,020	119,000	1.3
Raccoon		Number	
1971-72	80,632	9,000	11.2
1972-73	149,274	10,000	6.7
1973-74	184,688	9,000	4.9
		Value ($)	
1971-72	237,212	30,000	
1972-73	821,733	57,000	6.9
1973-74	1,317,660	61,000	4.6
Mink		Number	
1971-72	24,299	3,000	12.3
1972-73	44,062	6,000	13.6
1973-74	38,940	2,000	5.1
		Value ($)	
1971-72	97,196	14,000	14.4
1972-73	264,372	37,000	14.0
1973-74	272,580	13,000	4.8

Source: "Atchafalaya Basin Usage Study," 1975, as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin", F. W. Bell, 1981.

TABLE A-5-37

COMMERCIAL FUR CATCH IN THE ATCHAFALAYA RIVER BASIN [1]
(In Thousands)

Species	1971-72 Number	1971-72 Value ($)	1972-73 Number	1972-73 Value ($)	1973-74 Number	1973-74 Value ($)
Nutria	9	24	42	136	30	119
Raccoon	9	30	10	57	9	61
Mink	3	14	6	37	2	13
Muscrat	0	0	1	3	1	1
Beaver	[2]	1	0	0	0	0
Opossum	0	0	0	0	[2]	2
Other	0	0	0	0	[2]	4
TOTAL		69		233		199

[1] Day totals only
[2] Less than 0.5

Source: "Atchafalaya Basin Usage Study", 1975, as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin", F. W. Bell, 1981.

TABLE A-5-38

ESTIMATED GROSS RECEIPTS FROM TRAPPING

Species	Louisiana Number	Louisiana Value	Atchafalaya Basin [1] Number	Atchafalaya Basin [1] Value
		1977-78		
Nutria	1,714,083	$ 8,263,373	25,711	$123,950
Raccoon	192,845	1,967,022	14,463	147,527
Mink	28,101	252,909	2,950	26,555
		$10,483,304		$298,032
		1978-79		
Nutria	1,145,084	$4,823,094	17,176	$ 72,421
Raccoon	231,747	3,383,507	17,381	253,763
Mink	51,731	465,579	5,432	48,886
		$8,672,180		$375,070

[1] Nutria 1.5 percent of state
Raccoon 7.5 percent of state
Mink 10.5 percent of state

Source: Louisiana Department of Wildlife and Fisheries as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin", F. W. Bell, 1981.

Section 6 - CONDITIONS IF NO FEDERAL ACTION TAKEN (WITHOUT CONDITION PROFILE)

A.6.1. Because of the devastating effects that would result from not controlling flows into the Atchafalaya Basin at the Old River control complex and from not providing flood overflow restraint with the basin protection levees, there is not a true no-action alternative for this study. The conditions described below reflect a 70-30 flow distribution of total latitude flow below Old River control complex, with 30 percent regulated to the Atchafalaya River, and assumed continued development and maintenance of the basin protection levees to project flood levels by local or state interest.

Environmental Setting and Natural Resources

GEOLOGY AND SOILS

A.6.2. The changes in the geology of the basin are dependent upon the natural overflow process of the river, river water sediment deposition, and riverine changes. For this reason any further change in existing geology and soils will parallel the changes described previously.

CLIMATE

A.6.3. Changes in climate are unrelated to the projected without-project conditions in the basin. Natural changes will continue, but averages should approximate the average climatic conditions described in the previous section.

SEDIMENTATION

A.6.4. The process of a river overflowing its banks and depositing sediments in the adjacent land areas is a natural developing process of a young (in geologic time) river such as the Atchafalaya. Each year as the river conveys spring floods to the gulf, it will overflow its banks and continue to deposit sediments in the flooded overbank areas.

A.6.5. Projections of river overflow sediment deposits in the overbank areas are shown by the area-elevation curves for each management unit area (see Appendix C). As the natural levees within the Atchafalaya Basin build up to higher elevations from the yearly overflows, the quantities of water diverted to the overbank areas would gradually decrease; and therefore, the quantities of sediment deposited, or rate of sediment deposition on the overbank areas, would be expected to decrease over time. While the most significant amounts of deposition have already taken place over most of the basin, additional sediment deposition of up to 9 feet could occur in some areas.

A.6.6. The most significant areas of sediment deposition above the Teche Ridge would be in the Grand and Sixmile Lake areas. These areas are in a region where the main channel has yet to completely form natural levees; therefore, the overbanks are subject to frequent overflows and up to 9 feet deposition could be expected. This building of the river banks in the area would eventually result in the main channel having confining natural levees throughout the Lower Atchafalaya Basin Floodway. The filling of the open water areas would continue and ultimately would result in a relatively narrow channel through Sixmile Lake to Wax Lake Outlet.

A.6.7. Sediment deposition to the east of the main channel would not be as great in the distant backswamps. For most of the Upper Belle River area, deposition of less than 2 feet is expected. This large area receives only about 16 percent of the total basin discharge, and the waters reaching the area would have already lost their heavy sediment load during the long distance traveled from the main channel. Because of the small amount of deposition expected, this area should generally maintain its present water regime.

A.6.8. Like the Sixmile Lake area, higher deposition rates are expected in the southern and western portions of Upper Belle River as the main channel builds its natural levees; but since the main channel in this region is losing flow to Wax Lake Outlet, the deposition could be expected to be no more than 5 feet and be confined to those lands within a mile of the main channel.

A.6.9. The area of Crevasse would be subjected to up to 7 feet of sediment. This high rate of deposition is expected because practically all of the unit is located within the actively building natural leveed portion of the main channel, and because a significantly large volume of water flows through Lake Chicot, Grand Lake and Willow Cove during floods.

A.6.10. The Buffalo Cove area is bordered on the east by the main channel and on the west by Lake Fausse Pointe Cut. Because of the large flow conveyed through the west access channel and Lake Fausse Point Cut (15 percent of basin flow), Buffalo Cove is subject to

levee-building on both sides. Through the natural levee-building process which has already taken place, and the sediment disposal which was placed near the main channel, the eastern side of Buffalo Cove is already becoming a confining levee of the main channel. Along its western edge, particularly in the southwestern portion, water and sediment overflows into Buffalo Cove on a regular basis. In addition, access channels, such as the Si Bon Canal, convey a significant amount of water and sediment into the center of the area. These conditions would subject the entire area of Buffalo Cove to about 5 feet of additional sediment deposition.

A.6.11. The remaining hydrologic areas of the Lower Atchafalaya Basin Floodway are not subject to significant regular overflow patterns; therefore, expected deposition of sediment would be generally limited to the bank areas and be less than 5 feet. Exceptions to this general pattern are the Warner Lake and Alabama Bayou areas. Warner Lake is completely surrounded by high banks and only about one foot of additional deposition would be anticipated. Alabama Bayou is already well protected from main channel overflow by the east river levee. During times when the Morganza Floodway is not operated, it is subject only to overflow from backwater that has already passed through most of the Bayou des Glaises area. Thus, no additional sediment deposition would be expected in Alabama Bayou.

A.6.12. Sediment that passes through the Lower Atchafalaya Basin Floodway to the Atchafalaya Bay will continue to build the delta. As shown in Figure A-6-1, it is expected that about 300 square miles of land would emerge in this active deltaic process. If no action is taken to control flows through the Lower Atchafalaya River and Wax Lake Outlets, Wax Lake Outlet will capture a larger share of the flow to be conveyed to the gulf. For this reason, a westward shift in the delta-building process would take place, resulting in more land emerging near the mouth of Wax Lake Outlet.

HYDROLOGY

A.6.13. The cross-sectional area of the main Atchafalaya River channel, approximately above river mile 55, was in 1980 averaging about 118,000 square feet. The continued channel enlargement of this reach of the river would be minimal, with only about a 121,000 square-foot channel area expected by the year 2030. As the natural levees of the main channel in the Lower Atchafalaya Basin Floodway are built up, a larger percentage of the river flow will be confined to the channel, which will result in its continued natural enlargement. The channel's cross-sectional area between mile 54.8 and 65.4 is projected to increase from 92,000 square feet to about 110,000 square feet. Between mile 65.4 and mile 100.8, the channel cross section would increase from about 80,000 to 98,000 square feet.

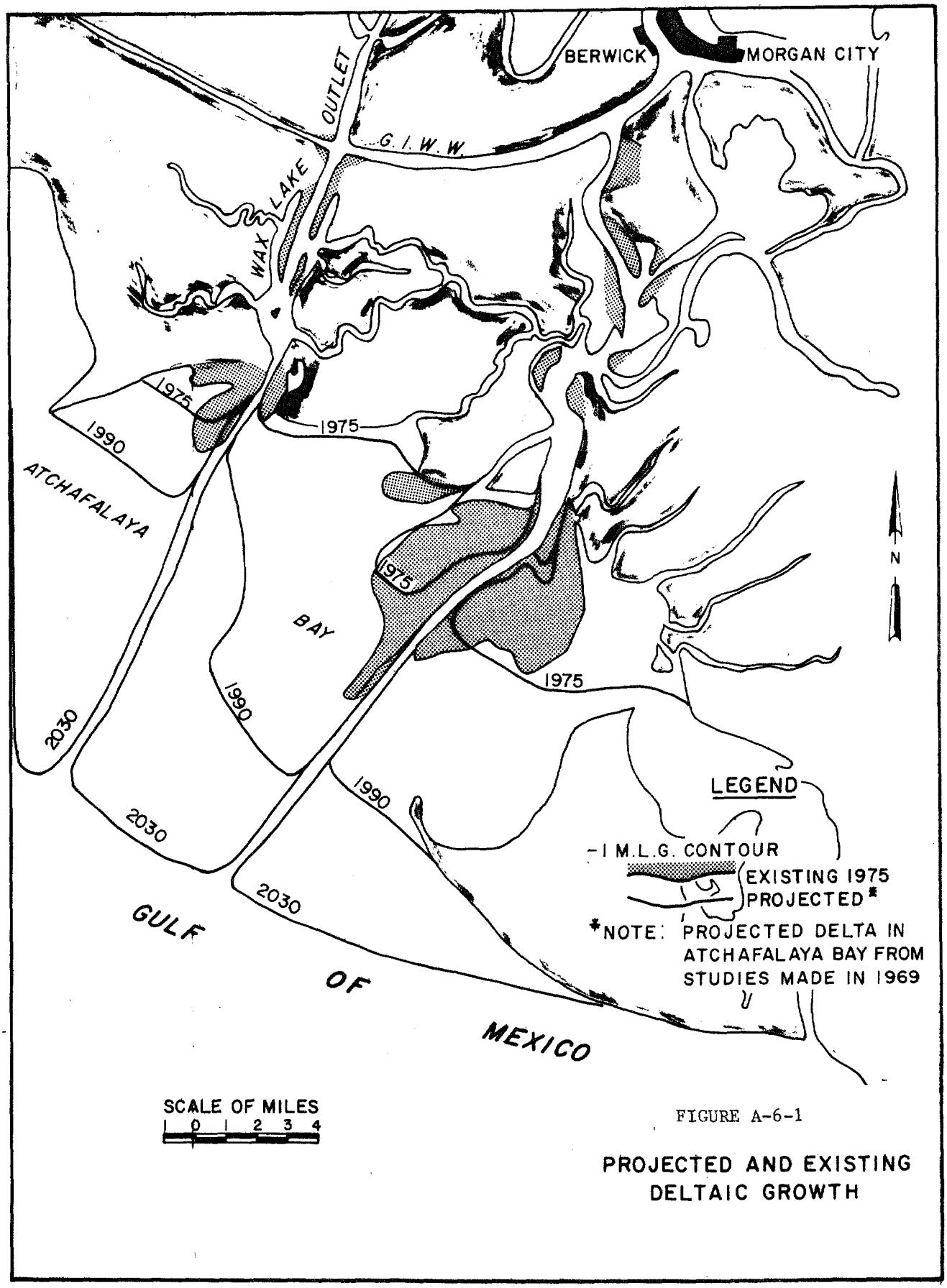


FIGURE A-6-1

PROJECTED AND EXISTING DELTAIC GROWTH

A.6.14. Wax Lake Outlet, with its gradient advantage over the Lower Atchafalaya River for flow to the gulf, will continue to convey an increasing percentage of the latitude flow. It is estimated that by 2030, approximately 50 percent of the latitude flow would be conveyed through the Wax Lake Outlet. Concurrent with this increasing flow, the cross-sectional area of Wax Lake Outlet will increase to about 51,000 square feet. Because of the concurrent decreases in flow, the main channel cross-section below river mile 100 would decrease in area. From mile 100.8 to mile 113.7 the area is projected to decrease in size from 38,000 square feet to about 17,000 square feet by 2030. The area of the Lower Atchafalaya River (mile 113.7 to 136.0) would decrease from 69,000 square feet to about 47,000 square feet.

A.6.15. This evident shift in the distribution of flow through the outlets, toward a larger part of the total flow being conveyed by Wax Lake Outlet, would have the effect of a loss in the total conveyance capacity of the outlets as exists in 1980. This, along with the projected overbank sediment deposition, would cause the project flood flowline to become higher than if some alternate action were taken. The no-action flowline is projected to be up to 1.5 feet higher than the 1973 refined flowline. This higher flowline effect extends along the East and West Atchafalaya Basin Protection Levee, Morganza Floodway levees, and the Atchafalaya River levees.

A.6.16. The no-action alternative or without-project condition affects the average stage hydrographs in the same manner as the project flood flowline. The peak stages expected for the average hydrograph would be higher for no-action than it would be if some preventive alternative actions are taken. The differences in magnitude are generally between 1 and 2 feet higher for all areas of the basin. This is shown in the average stage hydrographs for each management unit area (Plates C-28 through C-36 of Appendix C.)

A.6.17. As deltaic development of the Atchafalaya Bay continues, the mouth of the Atchafalaya River will continue to move gulfward, and stages at the end of the Avoca Island levee for a given discharge will continue to escalate. It is the stage at the end of this levee that governs the amount of backwater flooding that reaches the area northeast of Morgan City. For this reason, the backwater flooding problem in this area would continue to worsen with the no-action plan. The stage at Amelia, with the average return interval of 100 years, is expected to rise from 5.5 feet to 7.9 feet. Similar increases in stage are expected to occur throughout the backwater area.

Biological Resources

A.6.18. Vegetative associations and habitat types in the project area form a complex and continually changing pattern. The dynamic nature of this pattern is due to changes induced by varying water levels and hydroperiods, sediment deposition in open water and overbank areas, and changes in salinity. These naturally occurring processes are further altered by men who controls the flow at Old River, clears land for timber and agriculture, dredges canals, and builds levees.

A.6.19. As mentioned previously, the future without-project would include impacts caused by raising the existing levees associated with the project. This levee raising would be included in the without-project analysis because the basin is, first and foremost, a floodway and would probably continue to be maintained as such by local interests in the absence of a Federal project. Habitat changes which would be associated with this levee raising are shown in Table A-6-1.

TABLE A-6-1

HABITAT CHANGES THAT WOULD OCCUR DUE TO RAISING LEVEES IN THE PROJECT AREA TO MEET FUTURE WITHOUT-PROJECT FLOWLINE NEEDS FOR PROJECT FLOOD

Habitat Type	Acreage Gain or Loss
Late Successional Bottomland Hardwood	-8,215
Early Successional Bottomland Hardwood	-2,411
Cypress-Tupelo	-2,392
Cypress-Tupelo/Bottomland Hardwood Mix	-32
Open Land	+1,459
Fresh Marsh	-100
Bayous and Slow Canals	+11,691

A.6.20. The major change-producing processes in the basin are all interrelated and, acting together, they cause changes in habitat types. To evaluate these changes, the water levels, sedimentation rates, rates of land clearing, changes in salinity, etc., were projected into the future. Following consultation with a number of foresters, it was concluded that sediment deposition in the floodway would not adversely affect the bottomland hardwood habitat type. Due to the age of the early successional forests in the Henderson area, it was assumed that they would succeed to mid-successional hardwoods by 1990. However, when lowering of the water level and shortening of the hydroperiod would cause cypress-tupelo swamps to become flood-free three years out of five, from 1 June through 30 November, and it was assumed that they would succeed to a mix of cypress, tupelo, and bottomland hardwoods, such as ash and red maple, if they were not cleared for agriculture. When sedimentation or a combination of sedimentation and falling water levels was the cause of the swamp becoming flood-free, the area was assumed to succeed to a mix of cypress, tupelo, willow, and cottonwood. Occasionally, due to lack of knowledge of hydrology or stand age, or location of sediment deposition, it was necessary to assume that the swamp would convert to a forest of unknown category.

A.6.21. Following consultation with agricultural authorities, it was concluded that any lands flood-free, three out of five years from 1 June through 30 November, would be suitable to clear for agricultural use. Clearing was assumed to start in 1980 in the Henderson and Alabama Bayou areas, and in 1995 in the remainder of the basin except for the Upper Belle River and Sixmile Lake areas, which would be either too wet or impracticable to clear due to access problems, or which would be state-owned. It was further assumed that 80 percent of the lands suitable for clearing would be cleared during a 50-year period (past clearing trends in the West Atchafalaya Floodway indicate that the 80-percent figure is reasonable to use).

A.6.22. The cypress in the basin are nearing maturity and will soon be suitable for lumbering. It was assumed, after consultation with foresters familiar with logging operations in the area, as a worst case approximation, that 50 percent of the present cypress acreage would be cleared in increments of one percent per year during the next 50 years. It is difficult to project the eventual fate of such lands. If water levels drop or sedimentation occurs, some type of bottomland hardwood community would occur after clearing. If water levels increase, logged areas could convert to a marsh or open water habitat. If water levels remain near those at present, cypress could regenerate. In any case, tupelo, even if it were cut, would continue to grow in these areas because this species regenerates well from stump sprouts.

A.6.23. Table A-6-2 shows the expected changes in acreage of habitat types in those parts of the project area that would be affected by

CHANGES IN ACREAGE BY HABITAT TYPE
BETWEEN 1980 AND 2030 WITHOUT PROJECT

	Thousands of Acres		
	1980	2030	Gain or Loss
Early Successional Bottomland Hardwood	93.9	35.2	-58.7
Mid-to-Late Successional Bottomland Hardwood	332.0	186.1	-145.9
Cypress-Tupelo	451.0	415.0[1/]	-36.0
Bottomland Hardwood mixed with Cypress-Tupelo	8.4	20.2	+11.8
Composition Unknown	0	51.6	+51.6
Open Land	97.2	283.8	+186.6
Fresh Marsh	321.3	243.1	-78.2
Brackish Marsh	89.0	64.4	-24.6
Saline Marsh	107.3	67.3	-40.0
Delta	10.1	135.0	+124.9
Riverine and Distributaries	31.1	32.1	+1.0
Fresh Bayous and Canals	38.0	50.9	+12.9
Headwater Lakes	18.2	1.9	-16.3
Backwater Lakes	42.0	34.0	-8.0
Cropland Lakes	0.03	4.1	+9.07
Brackish Bayous and Canals	6.2	8.1	+1.9
Saline Bayous and Canals	6.1	7.4	+1.3
Fresh Marsh Ponds and Lakes	87.6	141.6	+54.0
Brackish Marsh Ponds and Lakes	55.2	75.3	+20.1
Saline Marsh Ponds and Lakes	64.4	99.0	+34.6
Fresh Bays	200.0	75.7	-124.3
Brackish Bays	58.9	58.9	0
Saline Bays	53.8	53.8	0
Shallow Gulf	804.0	804.0	0
Other	5.7	8.3	+2.6

[1/] One-half of this would be cut-over.

proposed project features during the next 50 years, if the project is not implemented. A brief discussion of the expected changes that could occur within these habitat types follows.

Terrestrial Resources

EARLY SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.6.24. The acreage of this forest type would decrease by about 59,000 acres or 60 percent (Table A-6-2). About half of this decrease would be due to the conversion of the existing 25,000 acres of old growth of this type within the Henderson area, to the mid-to-late successional bottomland hardwood category, or to clearing of these areas for agriculture. By 2030, much of the remaining 35,000 acres of early successional forest would have reached the mature stage and would contain a well-developed understory and ground cover. Thus it would be of moderate value to wildlife. Additionally, sedimentation within the lakes of the lower basin would cause the formation of some 20,000 acres of land. Much of this would probably become vegetated with the early successional forest type although the exact fate of such lands cannot be predicted with certainty. (For this reason, the forests forming on these accretion lands were assigned to the forested unknown category at the insistence of the EPA). Overall, the net change in the early successional forest acreage would be negative.

LATE SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.6.25. The acreage of this forest type would decrease by about 146,000 acres or 44 percent (Table A-6-2). This loss would be caused mainly by land clearing for agriculture. Much of the acreage remaining in 2030 within the lower floodway would be more mature and would contain a greater proportion of oak and sweetgum than it does today and would also contain more groundcover due to the shortening of hydroperiods that will occur as the Atchafalaya River matures. The changes would make these forests have a higher carrying capacity for many species of wildlife than is the case today, although this increase in carrying capacity would not make up for the loss in total acreage. In the backwater area northeast of Morgan City, however, rising water levels and increased duration of flooding would cause continued mortality to some stands of nonwater tolerant tree species and their replacement with some more water tolerant forms, such as bitter pecan and overcup oak. A corresponding decrease in the value of the habitat for certain terrestrial species of wildlife would, therefore, ensue.

CYPRESS-TUPELO SWAMPS

A.6.26. The overall decrease in cypress-tupelo acreage by the year 2030 would be about 36,000 acres (Table A-6-2). Most of this decrease would occur due to a conversion of this forest type to the bottomland hardwood mixed with cypress-tupelo category (see Table A-6-2), which would occur due to sedimentation and a lowering of water levels within the Lower Atchafalaya Floodway. A factor of far greater importance to the ecology of the basin than this loss of cypress-tupelo would be the harvest of these areas for timber. For a worst-case analysis, it was assumed that 50 percent of the acreage existing in 1980 would be cut-over by the year 2030. Thus, by 2030, half of the acreage of both cypress-tupelo and cypress-tupelo mixed with bottomland hardwoods would be harvested. These harvested areas might ultimately have either a higher or lower value as fish and wildlife habitat following logging, depending upon the successional pattern that develops. However, the initial effect of logging would be to lower the value of these areas, and recovery of former potential value might be slow. Rising water levels in the backwater area northeast of Morgan City could also have a detrimental effect upon the cypress-tupelo forests located there by causing slowed growth and reduced regeneration.

COMPOSITION UNKNOWN FORESTS

A.6.27. The acreage in the composition unknown category would increase from zero in 1980 to about 52,000 acres in 2030 (Table A-6-2). Approximately 20,000 of these acres would probably be early successional bottomland hardwoods that invade as the headwater and backwater lakes are filled by sedimentation. The remainder would be swamp mixed with either early successional or late successional bottomland hardwoods.

A.6.28. The value of these areas for wildlife would be directly dependent upon the age of the stand occurring on the accretion areas or the swamps; and therefore, the overall value of this habitat type should tend to increase with time.

OPEN LAND

A.6.29. The acreage of open land in the affected area would increase from about 97,000 acres in 1980 to 284,000 acres in 2030 (Table A-6-2). This is about a threefold increase and it would occur almost entirely as a result of the clearing of bottomland hardwood forests for conversion to agricultural land. The overall effect of this land conversion would be to greatly decrease the carrying capacity of the

affected areas for wildlife. Aquatic resources would also suffer from the loss of these periodically flooded forests in terms of reduced productivity.

MARSH AND DELTA

A.6.30. As can be seen from Table A-6-2, changes in marsh and related aquatic habitat types will be dynamic over the next 50 years. Fresh marsh would decrease from 321,000 acres in 1980 to 243,000 acres, a loss of 24 percent. Brackish marsh would decrease by 28 percent from 89,000 acres to 64,000 acres. At the same time, saline marsh would decrease from 107,000 acres to 69,000 acres, a loss of about half the existing saline marsh. As the Atchafalaya Bay delta grows from 10,100 acres today to 135,000 acres in 2030, most of the newly created land would become fresh marsh. Thus, on the balance at the end of project life there would be about 47,000 acres more fresh marsh, 24,500 acres less brackish marsh, and 38,000 less acres saline marsh than in 1980.

A.6.31. Marsh Loss and Gain. Marsh loss occurs for a variety of reasons: inner marsh deterioration, shoreline and bank erosion, dredging and filling activities, subsidence, and confinement of Mississippi River flows. A major cause of future marsh loss in the project area would be the reduction in river borne sediment transport to the western Terrebonne Parish marshes. This would occur because the developing delta would progressively reduce the cross-sectional area of the bayou mouths, such as Deer Island, Palmetto, and Carencro, thereby, decreasing the amount of sediment which reaches the marshes via these bayous. Thus, as time goes on, the loss rate in the Terrebonne marshes would continue to increase. The eastern Terrebonne marshes would not be influenced by this effect, and the loss rates there would remain as they are at present. In order to delineate what habitat type this marsh would become, preliminary raw data from the Wicker (1980) study was used. The study indicates that the majority of the deteriorating marsh becomes ponds.

A.6.32. Low flow salinity conditions are one of the most important factors used to determine marsh vegetative types. At the present time, the distribution of flow from the lower floodway is 70 percent Lower Atchafalaya River - 30 percent Wax Lake Outlet. In the future without-project, nearly 50 percent of the flow is expected to pass through the Wax Lake Outlet. It is almost impossible to quantify the changes in marsh-habitat type that would occur in the future because of the westward shift of the flow distribution. It is probable that some fresh marsh, especially in the area just east of Four League Bay, would become brackish. Some saline marsh near Point au Fer would probably become brackish, but in most of the project area the acreage

of saline marsh would expand northward. Because of the difficulty in predicting such changes, the 1980 boundaries of marsh habitat types were assumed not to change over the project life. Loss rates were then projected within each habitat type to calculate the 2030 marsh acreage.

A.6.33. Water levels in the marshes would rise over project life during average river flows, but not enough to significantly impact marsh acreage. Levels in fresh marshes would rise slightly over one foot, in brackish marshes approximately one foot, and in saline marshes less than one foot. This additional water would carry sediments and nutrients and this could balance the adverse physical impacts of flooding. For a 100 year flood, water levels in the marsh would rise significantly. The impacts of such a rise are difficult to estimate. Extensive permanent ponding could occur as the flood receded or ponds could be reclaimed by marsh plants in 3-10 years.

A.6.34. Adams and Bauman (1980) have predicted that most of Atchafalaya Bay will have been converted to delta by 2010. Thus by 2030 under future without-project conditions, 135,000 acres of delta would exist and the acreage would have increased at the expense of fresh bay. See Appendix G for further details on the methodology for calculating marsh and delta acreages.

Aquatic Resources

RIVER AND DISTRIBUTARIES

A.6.35. The amount of this habitat in the project area was assumed to increase slightly throughout the life of the project, due to bank erosion.

HEADWATER LAKES

A.6.36. Headwater lakes would decrease drastically from 18,200 acres in 1980 to only 1,900 acres in 2030 (Table A-6-2). The quality of the remaining lakes would be poorer than at present because of the increased agricultural runoff from the extensive land clearing that is expected to occur in the basin. As these lakes fill in, most would probably become early successional bottomland hardwoods. Some would remain aquatic habitat but become reclassified as cropland lakes. The loss of this headwater lake habitat would drastically impact fisheries production because these lakes are prime habitat for sport fish and crawfish. Zooplankton population cycles could be changed because

headwater lakes act as reservoirs from which many zooplankton species are washed out into other habitats.

BACKWATER LAKES

A.6.37. In the project area, the acreage of backwater lakes would decrease from 42,000 acres in 1980 to 34,000 acres in 2030 (Table A-6-2). However, the entire decrease would be due to sedimentation in the Lower Atchafalaya Floodway where acreage would decrease from 13,800 acres to 5,000 acres. Again, the majority of these filled lakes would probably become early successional bottomland hardwoods while some would be classified as cropland lakes. Water quality in backwater lakes in the floodway would be poorer in 2030 than at present due to the extensive agricultural development that would occur in the basin; however, backwater lakes northeast of Morgan City would not be so affected because agricultural encroachment would not occur.

CROPLAND LAKES

A.6.38. Cropland lakes would increase from 30 acres in 1980 to 4,100 acres by 2030 (Table A-6-2). This increase would not represent new lakes, instead lakes presently classified as headwater or backwater lakes would be classified as cropland once they were surrounded by agricultural lands. These reclassified lakes would not be as productive as in 1980; however, they would still support fish such as shad and carp. It is possible that fish from such lakes could be heavily contaminated with pesticides.

BAYOUS AND CANALS

A.6.39. Fresh bayous and canals would increase from 38,000 acres in 1980 to 50,900 acres in 2030 (Table A-6-2). Approximately 7,300 acres of this entire increase would be due to direct construction impacts of levee raising in the Lower Atchafalaya Basin Floodway and in the marshes south and west of Morgan City. This increase would provide valuable aquatic habitat because borrow pits, especially those on the floodside of the levees, are very productive in terms of fish and benthos. The remainder of the increase (5,600 acres) would occur as fresh marsh eroded. Brackish bayous and canals would increase from 6,200 acres in 1980 to 8,100 acres in 2030 (Table A-6-2) as brackish marshes eroded. Thus, the acreage of saline bayous and canals would increase from 6,100 acres in 1980 to 7,400 acres in 2030 due to erosion in saline marsh.

MARSH PONDS AND LAKES

A.6.40. Fresh marsh ponds and lakes would increase from 87,600 acres in 1980 to 141,600 acres in 2030 (Table A-6-2). As described earlier, this increase would come at the expense of fresh marsh. Brackish marsh ponds and lakes would increase from 55,200 acres in 1980 to 75,300 acres by 2030 (Table A-6-2). This increased acreage would come from deterioration of brackish marsh. Saline marsh ponds and lakes would increase from 64,400 acres to 99,000 acres while the saline marsh itself would decrease in acreage (Table A-6-2). Thus in summary, marsh ponds and lakes would increase by 50 percent from 207,200 acres to 315,900 acres. The total loss of marsh over the project life would be 140,800 acres. Ponds and lakes are valuable for fishery resources, but the lost marsh is even more vital. Marsh plants are the source of detritus that is the basis of the estuarine ecosystem in south-central Louisiana. Phytoplankton is also important in driving this ecosystem, but a square meter of pond will have a net primary production of only about 600 grams of dry weight per year (Day et al., 1973). A square meter of marsh will have a net production of approximately 2,200 grams of dry weight per year (Gosselink et al., 1977). The dramatic increase in ponds and lakes would provide habitat for fish, shellfish, and plankton but do little toward producing food to sustain them.

BAYS AND GULF

A.6.41. Brackish bays, saline bays, and shallow gulf would have the same acreage in the area in 2030 as they do in 1980 (Table A-6-2). Fresh bays would decrease from 200,000 acres in 1980 to 75,700 acres in 2030 (Table A-6-2). The land lost from Atchafalaya Bay would become delta as previously described. As the delta enlarges, salinities in the Cote Blanche-Vermilion Bay system would gradually decrease as more river water becomes available. Salinities in the Four League Bay-Lake Mechant-Caillou Lake system have been decreasing recently, and this trend is expected to continue over the project life.

Changes in Wildlife and Fisheries

CHANGES IN TERRESTRIAL WILDLIFE RESOURCES

A.6.42. The changes that would occur within the Atchafalaya Basin to terrestrial wildlife resources in the absence of a Federal project would be profound and significant. The loss of about 187,000 acres of forests and their conversion to open land used primarily for agriculture would be the major cause of this change, although the

changes in marshland acreages that would occur south of Morgan City would also be important. The most profound result of land use changes would be the reduction in population levels of forest-dependent animals. The fact that the basin is heavily utilized by migratory birds both as a breeding area and as a wintering area could cause these reductions in population levels to be felt far outside the study area, since the basin is the last remaining large-scale river swamp ecosystem in the Mississippi Valley. Loss of 187,000 acres of forest land could cause a continent-wide reduction in population levels of species that require the river swamp ecosystem to complete their life cycle. Other species that use the basin only temporarily during migration might be forced to alter their migration patterns or perhaps themselves become reduced in numbers.

A.6.43. To illustrate the magnitude of the changes that could occur to terrestrial wildlife resources, the theoretical estimated changes in the population levels of a group of representative species will be presented and discussed (Table A-6-3). These species are thought to be representative of a cross section of the terrestrial wildlife inhabiting all of the basin, and changes of a similar nature might be expected to affect other forms not discussed here.

TABLE A-6-3

ESTIMATED CHANGES IN THEORETICAL POPULATION LEVELS OF REPRESENTATIVE TERRESTRIAL SPECIES WITHIN THE ATCHAFALAYA BASIN SOUTH OF KROTZ SPRINGS[1/]

Species	1980 Population Level	2030 Population Level	Gain or Loss
Deer	12,400	10,700	-1,700
Swamp Rabbit	371,000	387,000	+16,000
Bear	50	None	-50
Wood Duck	15,000	14,000	-1,000
American Robin	453,000	295,000	-158,000
Clapper Rails	393,000	267,000	-126,400
Bobwhite Quail	15,000	34,000	+19,000
Mink	73,000	63,000	-10,000
Red-eyed Vireo	1,658,000	1,182,000	-476,000

[1/] Based on a survey of available literature and the personal knowledge of several biologists. These figures were calculated for comparative purposes only and do not necessarily represent actual population levels.

A.6.44. Deer. Deer populations would decrease by about 14 percent (Table A-6-3). Most of this decrease would take place within the Atchafalaya Floodway and would be due to conversion of forestland to agricultural land.

A.6.45. Swamp Rabbit. Swamp rabbit populations would probably increase by about 4 percent (Table A-6-3). The primary reason for this would be the increase in marsh acreage that would occur due to the growth of the Atchafalaya Delta. This increase in marshland would more than replace the population losses that would occur due to forestland conversion to farmland.

A.6.46. Bear. Bears are presently uncommon within the project area and occur primarily in the northern part of the basin. They would be eliminated due to the loss of forest habitat within the Atchafalaya Floodway System (Table A-6-3). Similar losses might be expected to occur to wild turkey populations, although it is possible that some turkeys might persist in the southern basin in the future.

A.6.47. Wood Duck. Resident wood duck populations would probably not decrease markedly (Table A-6-3). The greatest losses of these birds would occur in the bottomland hardwood areas that would be cleared for agriculture. However, an increase in the carrying capacity of cypress-tupelo swamps due to logging, which would tend to promote improved brood-rearing habitat, as well as stimulate the growth of emergent aquatics, would tend to offset these losses. It should be pointed out, however, that the overall impact of the future without-project condition on migratory wood duck populations would probably be more severe as the forested areas north of the project area, which are now used as wintering habitat by migrants, are cleared for agriculture. This forest removal would tend to make the remaining forested areas farther south even more important, and if these too are cleared, as would occur in the future without-project condition, then there might be too little wintering habitat in the future to support the existing migrant population in the Mississippi Valley.

A.6.48. American Robin. The American robin is an example of a songbird that uses the basin only as wintering habitat. Each winter thousands of these birds from distant points in the northern United States and Canada converge upon the area where they pass the colder months, then return north when spring arrives. Usage of the basin by these migrants would be drastically curtailed in the future and population levels could drop as much as 35 percent (Table A-6-3). The primary reason for this decrease would be the clearing of the late successional bottomland hardwood forests for agriculture.

A.6.49. Clapper Rail. Clapper rails are characteristic resident birds of brackish and saline marsh, and population levels could undergo as much as a 32 percent decline in the future. The reduction would be due almost entirely to the loss of about 65,000 acres of brackish and saline marsh.

A.6.50. Bobwhite Quail. Bobwhite quail, characteristic birds of farmlands, are presently uncommon within the project area due to the lack of suitable habitat. Quail population could increase as much as 126 percent (Table A-6-3) under the future without-project condition due to the expansion of agricultural activities within the basin. Similar increases in population levels of open land and forest edge species, such as mourning doves and cottontail rabbits, could be expected to occur also.

A.6.51. Mink. Mink are characteristic mammals of cypress-tupelo swamps and reach their highest population density there, but they also occur in the other habitat types of the project area. There could be as much as a 13 percent reduction in numbers of mink in the future (Table A-6-3). This would be due mainly to a loss of forestland due to agricultural conversion. Growth of the Atchafalaya delta would create some new mink habitat but not enough to offset these losses.

A.6.52. Red-eyed Vireo. The red-eyed vireo is an example of a migratory songbird that lives in the basin only during the breeding season. During the colder months, these birds live in South America. Like the American robin, these birds would be greatly affected by the future without-project condition. Population levels could decrease by as much as 29 percent (Table A-6-3) due to the conversion of forestland to agricultural land.

CHANGES IN FISHERY RESOURCES

A.6.53. The changes in fishery resources that would occur within the Lower Atchafalaya Basin and adjacent marshes in the absence of a Federal project would be dramatic.[1/] The most significant changes would be due to the conversion of 123,000 acres of annually flooded forested lands to agricultural lands. Other major impacts would be the net loss of 20,000 acres of lake habitat due to sedimentation and creation of 125,000 acres of delta. The major result of habitat losses would be a reduction in the harvest of freshwater fish and crawfish. To illustrate the magnitude of these losses, estimated reductions in harvest levels of some common species will be presented and discussed. Changes in the marsh-delta complex will be reflected in changes in harvest rates of estuarine dependent species.

A.6.54. As has been previously described, cypress-tupelo swamps, as well as early and late successional bottomland hardwoods function as

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[1/] Fishery losses in the backwater area northeast of Morgan City have not been calculated because of the lack of predictive data.

valuable aquatic habitat while they are flooded and also produce detritus that drives the aquatic food web. To estimate the impacts of the loss of this habitat, the amount of each habitat type flooded by the peak of the average shifted stage hydrograph was calculated for present conditions and for 2030. Harvest data were available for the Lower Atchafalaya Basin Floodway from National Marine Fisheries Service (NMFS) (Bell, 1981) and from the Atchafalaya Basin Usage Survey (Soileau et al., 1975). These data were utilized to determine the harvest in numbers or pounds per acre for 1980 and then the pounds per acre were reduced from 5 to 15 percent for 2030 due to predicted effects of increased turbidity and pesticides on overall productivity.

A.6.55. Crawfish. Crawfish harvest would drop by nearly 40 percent (Table A-6-4). Losses would occur in headwater lakes but the most dramatic decreases would happen because of loss of forested areas that are flooded each spring. Crawfish are heavily dependent on such areas.

TABLE A-6-4

ESTIMATED CHANGES IN HARVEST LEVELS OF
REPRESENTATIVE AQUATIC SPECIES
WITHIN THE ATCHAFALAYA BASIN FLOODWAY SOUTH OF KROTZ SPRINGS

Species	1980 Harvest	2030 Harvest	Gain or Loss
Crawfish	14,900,000 lbs	8,918,000 lbs	-5,982,000 lbs
Buffalo	1,100,000 lbs	756,000 lbs	-344,000 lbs
Catfish	2,185,000 lbs	1,384,000 lbs	-801,000 lbs
Largemouth bass	488,000 fish	296,000 fish	-192,000 fish
Sunfish	1,429,000 fish	858,000 fish	-571,000 fish
Penaeid shrimp	47,840,000 lbs	46,790,000 lbs	-1,050,000 lbs
Menhaden	173,240,000 lbs	170,000,000 lbs	-3,240,000 lbs

A.6.56. Buffalo. Buffalo harvest would decrease by approximately 30 percent (Table A-6-4). The heaviest losses would occur because of loss of forested habitat, especially swamps and headwater lakes. Since buffalo can withstand turbidity and pesticides better than other commercial fish, their numbers would decrease less than other species.

A.6.57. Catfish. The harvest of catfish would decline by approximately 37 percent (Table A-6-4). Again, the largest decrease in harvest would occur as wooded acres are cleared, but loss of headwater lakes would also be an important factor.

A.6.58. Largemouth Bass. The potential harvest would decrease by nearly 40 percent with major losses attributable to habitat loss in forests and headwater lakes (Table A-6-4). Losses would also occur as turbidity and pesticides levels increase as agriculture becomes common in the basin.

A.6.59. Bluegill/Warmouth/Redear Sunfish. Potential harvest of these sport fish would decline by 40 percent as the forested areas are cleared and headwater lakes become filled with sediment (Table A-6-4). Increased turbidity and pesticides would also contribute to this decrease.

A.6.60. Benthos of the Lower Atchafalaya Floodway. The numbers of benthic animals per acre of habitat type were obtained or extrapolated from Beck (1977). The estimated number of benthic organisms in 1980 is 3,200,000 million, while by 2030 the number would probably fall to 2,500,000 million, a decrease of 20 percent. Since these organisms are not common in wet bottomland hardwood forests, the major decreases would be due to sedimentation in swamps and headwater lakes, as well as to increase in pesticide and turbidity levels.

A.6.61. Estuarine Dependent Species of the Marshes and Bays. To estimate the change in harvest rates for estuarine-dependent organisms, the various estuarine habitat types were weighed as to their contribution to the production of penaeid shrimp and menhaden. The number of pounds harvested in the project area was gathered from NMFS data for 1963-73 in Hydrologic Units 6 and 7 (US Army Corps of Engineers, 1977) and from NMFS data for 1963-78 in Hydrologic Unit 5. To accurately assess the poundage of shrimp harvested, the inshore catch was increased threefold to account for unreported sport and commercial harvest.

A.6.62. Shrimp. The harvest of shrimp is estimated to drop slightly from the 1980 level (Table A-6-4). Decreases would occur in the harvest attributable to marsh and fresh bays, while the increases in harvest attributable to ponds, bayous, and delta marsh would nearly compensate for the loss.

A.6.63. Menhaden. Menhaden harvest is expected to decrease slightly (Table A-6-4). Again, losses would occur in harvest attributable to marshes and fresh bays, but increases would occur in all types of ponds and lakes, bayous, and delta marsh.

A.6.64. Endangered Species. Of the 14 endangered and two threatened species that are believed to occur or possibly occur within the

project area, three could be adversely and significantly affected under the future without-project condition. These are the ivory-billed woodpecker, Bachman's warbler, and the Florida panther. Loss of forestland in the northern parts of the project area would be the primary reason for this happening. In all probability, the ivory-billed woodpecker and Bachman's warbler would disappear entirely (Bachman's warbler may already be absent) and panther would become reduced in numbers in the areas north of Morgan City. Additionally, the expansion of agricultural activity in the northern basin would cause increased water pollution due to pesticides, and this could adversely affect other species such as the peregrine falcon, the bald eagle, and the brown pelican, all of which are particularly sensitive to this form of environmental stress.

A.6.65. Timber Resources. Loss of 187,000 acres of hardwood forestland due to conversion to farmland would greatly deplete the hardwood timber resources of the project area. Additionally, existing and future alterations in the hydrology of the lower floodway could make regeneration of the now existing cypress-tupelo forest difficult. Since these forests are approaching harvestable age and will probably be cut in the near future, this resource might be permanently lost if regeneration is in fact prevented by the altered hydrology of these areas.

A.6.66. Agricultural Resources. Under future without-project conditions, there would be an expansion of agriculture as the forestland areas are cleared. A net gain of about 187,000 acres of farmland would result primarily due to forestland conversion within the Atchafalaya Floodway system. It should be pointed out also, that about 7,000 acres of existing row-crop agricultural land in the backwater area northeast of Morgan City could go out of production due to rising water levels associated with the rise in flowline being created by delta development.

Cultural Resources

ARCHEOLOGICAL RESOURCES

A.6.67. If present conditions continue in the Atchafalaya Basin, there would be no direct benefit to archeological sites. Obscuration of archeological sites by sedimentation will continue. Mound sites reported by C. B. Moore in 1913, and reported to have been between 3 and 6 meters high, have virtually disappeared. The number of smaller and lower sites, masked in this manner, is inestimable, and if allowed to proceed will render site discovery and study more difficult.

A.6.68. Unregulated development would have detrimental effects on archeological sites. Canal dredging for oil operations will adversely impact sites. The clearing of land for lumber or in preparation for agriculture is destructive to sites by direct impact and indirectly through the increase of erosion.

A.6.69. Use of lands as agricultural fields further disrupts even fairly deeply buried sites because of plowing and the changes in the capillarity, percolation, and leaching of soils. If the Atchafalaya River main channel meanders or if there are shifts in its tributaries-distributaries, then archeological sites in those deposits will be destroyed. The general lack of archeological sites along the present channel attests to the channel's dynamic recent history.

A.6.70. The ongoing enlargement of the Atchafalaya Basin protection levees will adversely impact numerous cultural resources located in borrow areas and in the levee rights-of-way. The cultural resources survey conducted by University of Southwestern Louisiana of the levee construction areas identified numerous resources possibly eligible for inclusion in the National Register of Historic Places.

A.6.71. With no restrictions on activities in the basin, in all likelihood archeological sites would be mined for their shell deposits and indiscriminantly looted by pothunters.

HISTORIC RESOURCES

A.6.72. The effects listed for archeological sites hold for historic sites with the exception that standing historic structures are largely located within established communities and would be more subject to industrial site development impacts.

A.6.73. As the Atchafalaya River continues to become wider and deeper under the influence of the natural forces of erosion and scouring, any subsurface or underwater historic ship remains in the river would be adversely affected.

FOLK CULTURE

A.6.74. Under the without-project conditions, the continuing sedimentation and draining of the swamps would adversely impact the extractive economy base, and thus, the life style of the folk who live on the edges of the floodway. The deterioration of the economic resource base would have far-reaching effects upon folk culture.

A.6.75. Few people presently live in the floodway since the trend has been a movement to the margins of the basin where employment opportunities have increased. It is expected that this trend will continue and thus the amelioration of the isolation of Atchafalaya folk culture, and the former within-the-floodway settlement pattern would continue.

NATIONAL REGISTER PROPERTIES

A.6.76. Only two sites located within the Atchafalaya Basin Floodway have been determined eligible for inclusion in the National Register. The Avoca Island Pumping Plant Number 1, 16SMY52, has been avoided by the project and a determination of no effect has been executed. Any effects on the Nutgrass Site, 16SM45, and other possibly significant sites identified by the cultural resources survey, due to the enlargement of the Atchafalaya Basin protection levees, will have to be addressed in accordance with ER 1105-2-460 and 36 CFR, Part 800.

NATIONAL TRUST PROPERTIES

A.6.77. Under the without-project conditions, the only National Trust property near the study area, Shadows-on-the-Teche, would not be affected.

Population Characteristics

A.6.78. Projected population trends for the Atchafalaya Basin area by parish are presented in Table A-6-5. Only five of the 19 parishes in the area show any growth. The declining population in the remaining parishes is a result of the net out migration among young adults discussed in Section 5. For the area as a whole, population growth of about 0.4 percent compounded annually over the 1980-2030 period is projected. Other population characteristics are more difficult to forecast, although trends over the period 1980-2030 can be qualitatively described. During this period, it is expected that the median age of the population in the area would rise slightly, as would educational achievement levels.

TABLE A-6-5

POPULATION PROJECTIONS FOR PARISHES IN ATCHAFALAYA BASIN AREA

Parish	1980	1990	2000	2010	2020	2030
Assumption[1/]	21,800	24,400	29,900	34,800	39,400	44,600
Avoyelles	37,900	38,100	37,500	36,800	36,200	36,200
Caldwell	9,400	9,400	9,300	9,100	9,000	9,000
Catahoula	11,800	11,900	11,700	11,500	11,300	11,300
Concordia	22,600	21,900	20,500	19,500	18,500	18,500
Franklin	24,000	23,200	21,800	20,700	19,600	19,600
Iberia	52,300	51,600	49,200	48,000	46,300	46,300
Iberville[1/]	31,700	32,800	33,800	34,700	35,600	36,500
Lafourche[1/]	81,300	95,200	122,500	147,700	171,200	198,400
LaSalle	13,300	13,400	13,200	13,000	12,800	12,800
Ouachita	128,600	139,600	146,100	149,700	153,200	156,800
Pointe Coupee[1/]	21,100	20,000	18,900	17,800	16,900	16,900
Richland	21,800	21,100	19,800	18,800	17,800	17,800
St. Landry	73,200	72,200	58,900	66,900	64,800	64,800
St. Martin	29,600	29,100	27,800	27,000	26,200	26,000
St. Mary	55,300	54,600	52,100	50,600	49,000	49,000
Tensas	9,700	9,400	9,100	8,900	8,800	8,800
Terrebonne	81,700	87,600	91,300	94,300	96,300	98,300
West Baton Rouge	19,300	21,900	24,000	25,800	27,000	28,300
TOTAL	727,100	755,500	783,400	809,800	832,900	900,100

[1/] These parishes are also included within the New Orleans to Baton Rouge Metropolitan Area (NOBRMA) Study Area, and the projections shown above for these parishes were derived for that study. All other projections were based on the source listed below.

Source: US Army Corps of Engineers, based on "1972 OBERS Projections of Regional Economic Activity in the United Stated--Series E Population", US Water Resources Council, and the Series E demographic projections of the Bureau of the Census.

MAJOR SKILLS AND OCCUPATIONS

A.6.79. The 1972 OBERS projections do not include employment forecasts by skill or industry groupings, but the growth of employment in different skill/industry classifications may be inferred by examination of the OBERS forecasts of industrial earnings growth in the study region. For Bureau of Economic Analysis (BEA) Economic Area 139, Lake Charles, Louisiana, which includes a large portion of the study region and is the BEA's most representative of employment opportunities available to residents, Table A-6-6 presents the most significant growth of industries.

TABLE A-6-6

SIGNIFICANT INDUSTRIAL GROUPS IN THE STUDY AREA
(BASED ON PRESENT AND PROJECTED EARNINGS GROWTH IN
BEA ECONOMIC AREA 139, LAKE CHARLES, LOUISIANA

INDUSTRY	1980 TO 2020 GROWTH FACTOR (PERCENT)
Wholesale and Retail Trade	156
State and Local Government	261
Crude Petroleum and Natural Gas (Exploration and Production)	53
Petro-Chemicals (Manufacturing)	230

A.6.80. The four industries listed in Table A-6-6 represent 42 percent of the total earnings in BEA Area 139 in 1980. The weighted growth factor in these four industries for the period 1980-2020 is 176 percent. The weighted growth factor for all industries in BEA 139 during the same period is forecast to be 194 percent. As a result, the share of these four industries, as measured by growth of earnings, in the total BEA economy would slip to 40 percent. In summary, these

four industries represent the most significant employment opportunities for residents of the Atchafalaya Basin area and will continue to do so for several decades.

EDUCATION

A.6.81. The average median number of school years completed among persons 25 years and over for parishes in the study area is expected to increase only slightly in the near future and remain below the average for both Louisiana and the nation.

RURAL AND AGRICULTURAL DEVELOPMENT

A.6.82. The most significant agricultural development in the area during the next several decades, in the absence of government action, would be the conversion of forestland to agricultural production. In the Lower Atchafalaya Basin Floodway, conversion of almost 200,000 acres of forestland is to agricultural land would be expected to occur. Table A-6-7 shows by decade the projected land clearing in the floodway. In the backwater area northeast of Morgan City no conversion of forestland to agricultural production is projected.

TABLE A-6-7

PROJECTED LAND CLEARING IN THE
LOWER ATCHAFALAYA BASIN FLOODWAY
(ACRES)

Year	Agricultural Land	Increment
1980	15,200	
		+13,000
1990	28,200	
		+54,500
2000	82,700	
		+70,300
2010	153,000	
		+33,000
2020	186,000	
		+16,000
2030	202,000	

A.6.83. The land clearing projected for these areas is a continuation of a process that has been ongoing in the lower Mississippi Valley for decades. The motivation for this changing land use is economic. From a monetary standpoint, the best use of the land, once it becomes relatively flood free, is soybean production.

A.6.84. According to crop budget data for soybean production, developed by Louisiana State University, the typical acre of land used to grow soybeans in the Atchafalaya Basin would generate net returns of approximately $75 per acre. Alternatives to soybean production, such as forestry and recreation, do not on average yield more than $20 per acre. The excess of the agricultural returns over the fees earned from alternative uses would average $55 per acre. The present value of an annuity of $55 per year for 100 years at 7-5/8 percent is approximately equal to $720. Given an initial conversion cost for land clearing and preparation of approximately $350 per acre, it is apparent that the profit-maximizing landowner will convert his land from forest to soybean production. (This condition is unadjusted for occasional flooding. Assuming an entire crop is lost, an average of one out of every five years, the average yearly return per acre is approximately $60. Accordingly, the excess of returns over alternative fees would be $40 per acre. The present value of this $40 annuity for 100 years at 7-5/8 percent would be approximately equal to $525.) Aside from the significant boost in demand for agriculture-related goods and services that this land use conversion would entail, the major impacts would be a reduction in forestry activities and recreational opportunities on the converted land.

A.6.85. In the absence of Government action, a further impact to agricultural lands will occur. As a result of rising water levels in the backwater area, approximately 10,000 acres of existing row-crop agricultural land would be forced out of production. This loss would occur primarily in the southern portion of the backwater area where stage increases would be the most dramatic. It should be noted that because protection, in the form of small levees and pumps, would be feasible for some acres, the actual loss would be less than the estimated potential 10,000 acres, which represents the worst-case situation.

A.6.86. Rural economic activity in the study area would be expected to expand with the development of water-based business activity in the upper portion of the lower floodway as part of the without-project condition. South of Krotz Springs, the higher lands adjacent to or in proximity to the main channel of the Atchafalaya River would be well suited for development by industry, which would require water access for transportation.

A.6.87. A significant factor to rural development in the study area would be the large number of structures, mostly camps and some permanent residences, that would be adversely affected by raising the

levees that comprise the Atchafalaya Basin Floodway system. This levee raising, which is required primarily due to subsidence, is viewed for purposes of this study as part of the without-project or no-action condition. To date, approximately 63 structures have been affected by levee raising already performed. Additionally, it is estimated that approximately 770 structures would be impacted by the remaining required work. Of the 770 structures, over 95 percent are located along the West Atchafalaya Basin Protection Levee.

A.6.88. An additional impact for many residents residing near the urban center of Morgan City would be the increased flood hazard resulting from increased backwater stages. In general, all residents of the backwater area northeast of Morgan City would be faced with rising stages if no Government action is taken. The largest number of these affected residents, however, would be located near the eastern edge of Morgan City. Table A-6-8 shows the total number of backwater

TABLE A-6-8

BACKWATER AREA POPULATION INUNDATED
BY SELECTED FREQUENCY EVENTS,
EXISTING AND FUTURE WITHOUT CONDITIONS

Existing Conditions (1980)

Event Frequency (Years)	Population
5	100
10	100
25	100
50	1,300
75	2,500
100	3,400

Without Condition (2030)

Event Frequency (Years)	Population [1/]
5	3,400
10	3,600
25	14,800
50	15,100
75	15,100
100	16,400

[1/] Affected population in 2030 is based on the existing population level.

area residents inundated by various frequency events for existing (1980) and future (2030) conditions, assuming no response by area residents to the increased flood hazard. This table shows that there would be significant increases in the number of inundated residents at all frequencies. For the higher frequency events, the area near Morgan City constitutes more than half of this affected population.

URBAN DEVELOPMENT

A.6.89. Growth in the urban centers, listed in Section 5, is expected to occur as population shifts from the rural areas of the area parishes to the urban centers. The continued importance of the wholesale and retail trade, petro-chemical processing, oil and gas exploration and production, and manufacturing serve to stimulate the growth of the urban centers.

EMPLOYMENT AND INCOME

A.6.90. As described in Section 5, the study area has consistently ranked lower than Louisiana in per capita personal income since 1950. Since no non-SMSA parish projections for personal income exist, US Department of Commerce, Bureau of Economic Analysis non-SMSA portions of Water Resource Subareas will be used instead of parish level projections. Water Resource Subareas (WRSA) 0807, 0808, and 0809 include a large portion of the Atchafalaya Basin Study area and will be used to demonstrate the trends in per capita personal income for the study area. Table A-6-9 presents these projections. While per capita personal income for all three WRSA's shows gains relative to that of the nation, they still lag behind state per capita income.

A.6.91. Table A-6-10 presents projections of total employment and employment/population ratios for the above-mentioned WRSA's, as well as for the entire state. As discussed in Section 5, the study area unemployment rate has been slightly higher than the statewide figure. The employment and employment/population ratios shown in Table A-6-10 suggest that this condition would not change significantly in the foreseeable future.

TRANSPORTATION

A.6.92. The most important development in the area's transportation network will be a north-south interstate highway to be constructed during the mid-1980's, linking Lafayette, Alexandria, and north Louisiana cities. This new transportation artery would stimulate

TABLE A-6-9

RELATIVE PER CAPITA INCOME PROJECTIONS

	1980	1990	2000	2010	2020	2030
Per Capita Income Relative (US = 100)						
Non-SMSA portion WRSA 0807	0.63	0.66	0.70	0.73	0.77	0.81
Non-SMSA portion WRSA 0808	0.68	0.70	0.72	0.75	0.78	0.81
Non-SMSA portion WRSA 0809	0.73	0.75	0.78	0.80	0.83	0.86
Louisiana	0.79	0.81	0.83	0.85	0.88	0.91

Source: US Department of Commerce, Bureau of Economic Analysis, "1972 OBERS Projections of Regional Economic Activity in the U.S.--Series E Population, Non-SMSA Portions of Water Resources Subareas" and "1972 OBERS Projections of Regional Economic Activity in the U.S.--Series E Population, States."

TABLE A-6-10

PROJECTIONS OF TOTAL EMPLOYMENT

1980	1990	2000	2010	2020	2030	
Non-SMSA Portion WRSA 0807						
Total Employment	85,600	92,000	99,200	101,300	103,500	105,700
Employment/population ratio	.32	.33	.35	.36	.37	.38
Non-SMSA Portion WRSA 0808						
Total Employment	160,700	160,900	161,500	159,100	156,700	156,700
Employment/population ratio	.36	.36	.38	.39	.39	.39
Non-SMSA Portion WRSA 0809						
Total Employment	95,300	105,200	116,400	122,100	128,000	134,200
Employment/population ratio	.34	.35	.37	.38	.38	.39
Louisiana						
Total Employment	1,379,800	1,477,800	1,589,700	1,634,900	1,681,300	1,729,100
Employment/population ratio	.37	.38	.40	.40	.41	.42

Source: US Department of Commerce, Bureau of Economic Analysis, "1972 OBERS Projections of Regional Economic Activity in the U.S.--Series E Population, Non-SMSA Portions of Water Resources Subareas" and "1972 OBERS Projections of Regionial Economic Activity in the U.S.--Series E Population, States."

development in the urban centers of Lafayette and Alexandria and may also improve employment opportunities for residents of the area who live near the new interstate highway.

OIL, GAS, AND MINERALS

A.6.93. No known long-term projections specific to the Atchafalaya Basin are available. This area is an important producing region for oil and natural gas and this is expected to continue in the forseeable future.

TIMBER

A.6.94. As discussed in Rural and Agricultural Development, the projected land use conversion in the Lower Atchafalaya Basin Floodway would significantly affect the forestry industry. Table A-6-11 shows the loss of late successional bottomland hardwoods by decade for the basin. The loss of these lands due to the conversion to agriculture will be substantial, amounting to approximately 137,000 acres.

PARKS AND RECREATION

A.6.95. The future without-project alternative with its resulting physical and biological impacts on the Lower Atchafalaya Basin Floodway will directly affect recreation.

A.6.96. The central channel of the basin would continue to become wider and deeper under the influence of the natural forces of erosion and scouring. As a result, large-scale changes in the land and water configurations of the floodway would occur. The self-enlarging of the river channel would increase its carrying capacity, thus leading to a draining of the swamps. Open water would convert to land and low land would become lands of higher elevation. Vegetative cover would change on these lands through natural succession. These changes in land and water patterns, occurring over time, would impact future land and water-based recreational activities.

A.6.97. Land use projections indicate that under the without-project conditions, as much as 44 percent of the mid-to-late successional bottomland hardwoods alone, or 146,000 acres, would be cleared and converted into agricultural land suitable for planting crops. Land conversion would have an adverse impact on big game and most forms of small game hunting, since both activities occur predominantly in areas

TABLE A-6-11

LATE SUCCESSIONAL BOTTOMLAND HARDWOODS IN
THE LOWER ATCHAFALAYA BASIN FLOODWAY
(ACRES)

Year	Total	Increment
1980	247,000	
		+ 10,000
1990	257,000	
		- 53,000
2000	204,000	
		-59,000
2010	145,000	
		- 24,000
2020	121,000	
		- 11,000
2030	110,000	

of bottomland hardwoods, the prime habitat for deer, turkey, and squirrel. A total of 55,500 user days of hunting supply would be lost annually by the year 2030 under the without-project conditions as a result of extensive land conversion. If this trend persists, at least an additional 25,000 acres would be cleared by 2080 resulting in an additional loss of 9,500 annual recreation user days. Other land-based activities occurring in the floodway, such as birdwatching, nature walking, hiking, and primitive camping, although nonquantifiable, would be adversely affected with the loss of vegetative cover that supports such activities. As a result, an overall loss in existing and potential recreational use would be realized. Future use would more heavily impact remaining lands because of projected higher user concentrations.

A.6.98. The quantity and quality of the recreational experience would be negatively impacted as more and more users compete for the remaining yet shrinking resources. In many instances, the recreational potential for a particular recreational activity would be completely displaced or lost as a result of land conversion. Lands that are now being leased by hunting clubs, but which would be replaced by soybean fields because of future greater economic returns, is a prime example of a lost resource.

A.6.99. As the swamps drain and bottomland hardwoods are cleared, water regimes and water quality would be adversely

impacted by sedimentation, accretion, and pollution from agricultural runoff. The diminution and degradation of total water acreage would result in an overall decrease in the amount of quality water-based recreation available. Most of the loss in terms of water acreage would occur in headwater and backwater lake areas. A loss of 24,300 total surface acres overall is projected for the lake aquatic habitat types over the project life under the without-project conditions. Generally, these are the areas most heavily used for fishing, boating, and canoeing. Although this acreage loss would not preclude any future use based upon boat-launching access and an overall available surplus acreage of water resources, it would, however, decrease the potential for a quality outdoor experience while concentrating future usage into the remaining acres.

A.6.100. Mineral extraction in the basin floodway would continue under the without-project conditions and under all other plan alternatives. Canals and pipelines would continue to be constructed, interrupting the natural esthetics of the basin floodway to a greater degree than that of the present.

A.6.101. The tendency for a greater percentage (from 30 to 50 percent) of the total flow of the Atchafalaya River to discharge into the Gulf of Mexico through Wax Lake Outlet would occur over time under without-project conditions.

A.6.102. This shift in flows, along with concurrent delta development, would cause a loss in fresh bays in the marsh area. Thus, recreational estuarine fishery resources decrease.

A.6.103. Delta building and marsh land accretion would occur as the flow of water and sediments into Atchafalaya Bay continues. Additions to the land mass that currently exist in the Atchafalaya Delta Wildlife Management Area would improve waterfowl habitat, as well as habitat for furbearers. With an increase in habitat, potential for consumptive recreational activities, such as hunting and trapping, would be enhanced in the Atchafalaya Delta area, although total net losses resulting from land conversion are much too great to be offset by these minimal increases.

FISHING, HUNTING, AND TRAPPING (COMMERCIAL ASPECTS)

A.6.104. In the absence of Federal action, commercial fishing and trapping will be adversely affected by decreasing water levels and the clearing of woodlands within the lower floodway. Additionally, the creation of delta in the Atchafalaya Bay area would probably impact favorably on commercial fishing and trapping.

A.6.105. The net impact of these effects on commercial fishing is expected to be adverse. In the project area, the loss of forest wetland would result in reduced production levels for all species. In the Atchafalaya Bay area, the loss of certain marsh types would be offset by the process of delta creation. For the bay area, the impact of this redistribution on commercial fishing could be expected to be neutral. In summary, therefore, the net impact on commercial fishing is expected to be adverse. For the three dominant species taken in the basin, crawfish, catfish, and buffalofish, it is estimated that maximum sustainable yield in the lower floodway could drop by as much as 39, 37, and 31 percent, respectively.

A.6.106. The overall net impact on commercial trapping is expected to be negative. In the lower floodway, the loss of suitable habitat would result in population reductions for mink, nutria, and racoon of 28, 15, and 32 percent, respectively. In the lower Atchafalaya River complex populations are not projected to vary as significantly. The mink population is projected to be stable; whereas, nutria would increase slightly (4%) and raccoon would decrease slightly (2%).

INDUSTRY

A.6.107. As described in Section 5, the principal industries in the study region are industrial and miscellaneous chemicals and allied products, food and kindred products, sugar, and lumber and wood products. The Morgan City area is of great significance to the region's industry as it is the focal point for the manufacture of items used in the exploration and production of oil and gas resources in the Louisiana Gulf region.

A.6.108. Perhaps the most significant development to the study region's industry in the absence of Government action would be the effects of rising backwater stages on the Morgan City area industrial complex. The unprotected industry located along US Highway 90, stretching several miles in an easterly direction from the eastern edge of Morgan City, would be most severely impacted. For the infrequently occuring event (100-year frequency) water levels would rise by as much as 2.0 to 2.5 feet above existing (1980) conditions. In addition to experiencing higher stages, the frequency of property damaging stages in this area would also increase. The existing property damaging stage occurs at a frequency of approximately once every 35 years. By the year 2030, this frequency would increase to about once every two years. In the absence of a response by affected industry to this significantly increased flood hazard, annual flood damages would increase dramatically. Under existing conditions average annual physical damage to the industrial development along this stretch of US Highway 90 is estimated to be approximately $300,000. These damages would increase to approximately $15.1 million

by the year 2030. This increase in damage is based on the current development. In addition to the physical damage caused by higher stages, the duration of property-damaging stages would increase, resulting in prolonged interruptions to the production process.

A.6.109. It is questionable whether industry in this area would continue to incur annually increasing flood damages and disruptions. When damages and disruptions reach some critical level, occupants of this area would be induced to relocate. This process would be accelerated when these industries are confronted with major decisions on capital replacements. If some or all of these industries are forced to relocate, the impact on the area's economy would be most severe.

Section 7 - PROBLEMS, NEEDS, AND OPPORTUNITIES.

A.7.1. In discussing the problems, needs, and opportunities of the area, it is helpful to isolate the problems and corresponding needs. Table A-7-1 contains a summary of problems and needs of the study area. Within the framework of the goals and objectives of the Agency Management Group (see Section 9 of this Appendix), a dominant objective and the common denominator for any proposed action is that the project must be able to convey the design floodflows (while protecting life and property adjacent to the floodway). The problems relating to this objective must be solved and needs must be met. The other needs, including preserving or enhancing environmental values, providing for public recreation opportunities, and maximizing delta development, must be met within the framework of providing an adequate flood control system.

Old River Control Complex and the Red River Backwater Area

A.7.2. The Old River control structure and the Morganza control structure serve as the inlets to the floodway system, and have been described in detail in Section 4 of this Appendix. The problems and needs of this area are presented in the following paragraphs.

DEFICIENCIES IN OLD RIVER CONTROL COMPLEX

A.7.3. Since its construction (1959-1962), the Old River Control complex has experienced numerous hydraulic and structural problems in the form of scouring damages, marine accidents, and stilling basin damages. A summary of the damages and repairs, shown in Table A-7-2, reflects that scour has been the most common problem. Experience has shown that scouring problems rapidly increase as the differential head (headwater stage minus tailwater stage) at the low sill structure approaches or exceeds 13-16 feet, depending on the gate positions. Rehabilitation work since 1973 has improved hydraulic flow characteristics at the structure and provided increased scour protection both upstream and downstream. This has reduced the potential for future scour damages but has not completely eliminated it.

A.7.4. There is a structural constraint on the low sill structure resulting from 1973 flood damages. In that flood, foundation material

TABLE A-7-1

PROBLEMS AND NEEDS

Item	Problems	Needs
Old River Control and Red River Backwater Area	1. Deficiencies in Old River Control complex: a. Weakened low sill structure. b. Channel scour problems. c. Draw on river traffic. d. Control over sediment diversion	1. Convey the design flows for flood control.
	2. Observed deterioration of Mississippi River channel.	2. Prevent the Mississippi River from changing its course.
	3. Flow regulation through the Old River low sill structure.	3. Regulate flow into the Atchafalaya River to: a. Decrease water levels in the Red River Backwater Area to enhance agricultural productivity. b. Increase water input to the Atchafalaya Basin for the enhancement of aquatic resources.
Atchafalaya Basin Floodway System. This includes the West Atchafalaya Floodway, the Morganza Floodway, and the Lower Atchafalaya Basin Floodway.	1. The present conveyance capacity in the lower floodway is inadequate for major floods, due to: a. Poor levee foundations. b. Continuing overbank sedimentation. c. Immature main channel. d. Incomplete levee system.	1. Convey the design floodflows through the floodway.
	2. The environment of the basin is rapidly changing, due to: a. Changing water regimes resulting from natural and man-made actions. b. Sedimentation. c. Land conversion actions.	2. Maintain the unique environment of the Atchafalaya Basin.

TABLE A-7-1

PROBLEMS AND NEEDS

Item	Problems	Needs
Old River Control and Red River Backwater Area	1. Deficiencies in Old River Control complex: a. Weakened low sill structure. b. Channel scour problems. c. Draw on river traffic. d. Control over sediment diversion	1. Convey the design flows for flood control.
	2. Observed deterioration of Mississippi River channel.	2. Prevent the Mississippi River from changing its course.
	3. Flow regulation through the Old River low sill structure.	3. Regulate flow into the Atchafalaya River to: a. Decrease water levels in the Red River Backwater Area to enhance agricultural productivity. b. Increase water input to the Atchafalaya Basin for the enhancement of aquatic resources.
Atchafalaya Basin Floodway System. This includes the West Atchafalaya Floodway, the Morganza Floodway, and the Lower Atchafalaya Basin Floodway.	1. The present conveyance capacity in the lower floodway is inadequate for major floods, due to: a. Poor levee foundations. b. Continuing overbank sedimentation. c. Immature main channel. d. Incomplete levee system.	1. Convey the design floodflows through the floodway.
	2. The environment of the basin is rapidly changing, due to: a. Changing water regimes resulting from natural and man-made actions. b. Sedimentation. c. Land conversion actions.	2. Maintain the unique environment of the Atchafalaya Basin.

TABLE A-7-1
(Continued)

PROBLEMS AND NEEDS

Item	Problems	Needs
	3. Future navigation access is threatened by: a. Changing water regimes b. Sedimentation.	3. Maintain navigation access.
	4. Existing public recreation access is inadequate.	4. Provide public recreation access and opportunities.
Outlets of the floodway system, including Wax Lake Outlet and the Lower Atchafalaya River	1. The present combined capacity of the two outlets is inadequate for major floods, due to: a. Insufficient channel cross section b. Insufficient levee height and overbank flow area. c. Lack of control over the distribution of flow between the two outlets.	1. Convey the design floodflows out of the floodway, through the Teche ridge and into the Gulf.
	2. Navigation problems through Berwick Bay.	2. Maintain navigation access through Lower Atchafalaya River.
Lower Atchafalaya River backwater complex, including the area northeast of Morgan City and the Terrebonne marshes.	1. The present protection from backwater flooding is inadequate due to: a. Rising flowline. b. Development (Industrial, commercial, residential and agricultural) in low lying areas. c. Insufficient channel capacity in the Lower Atchafalaya River. d. Lack of control over the distribution of flow between the two outlets.	1. Provide protection against backwater flooding induced by flood flows in the Lower Atchafalaya River.
Atchafalaya Bay, including the marshes adjacent to the bay	1. Future management plans are not defined due to: a. Rapidly changing conditions b. Insufficient technical data.	1. Provide a management plan for the Atchafalaya Bay and adjacent marshes.

TABLE A-7-2
(Continued)

PROBLEMS AND REPAIRS

Date	Problem/Damage	Location	Repair	Cost ($)
Aug 71	Scouring	Inflow channel	4,700 squares concrete mattress	131,000
Apr-Jun 73 (73 flood)	Scour hole -60 ft. NGVD	Forebay, wingwall and under structure	335,000 tons riprap, 33,000 cu. yd. grout	16,542,000 1/
Oct 73-Aug 74	Marine accident	Gate bay 5	-	-
Apr-Jun 74 (74 high water)	Scour hole bank erosion -120 ft. NGVD	Outflow channel	210,000 tons riprap	*
Mar 75 (75 high water)	Scour	Forebay	8,700 tons riprap	324,000
Aug-Dec 76	Stilling basin repair	Stilling basin	-	-
Sep 77	Scouring	Outflow channel	-	-
Sep 79	Scouring	Overbank structure	-	-
Nov 80	Stilling basin repair	Stilling basin	-	-

1/Total cost of repairs performed during 1973 and 1974 high water during a continuing repair contract, including exploratory drilling.

beneath a portion of the low sill structure was undermined and eroded, permanently weakening the structure. Subsequent to the 1973 structural damage, a detailed foundation, hydraulic, and structural analysis of both the low sill and overbank structures was made. This analysis is contained in Design Memorandum No. 12, "Stability Analysis, Old River Low Sill and Overbank Structures, FC, MR&T, Old River Control, Louisiana". The analysis indicated that, in addition to the structural and foundation problems, future hydraulic conditions will be more adverse than anticipated during design of the complex. As a result of the analysis, subsequent model tests and investigations, and subsequent letter reports, an extensive rehabilitation program for the Old River project has been initiated. Rehabilitation measures that have been completed or are planned are shown in Table A-7-3. The direct rehabilitation of the Old River complex is essentially completed and the low sill structure, with a single exception, is a dependable and damage-resistant structure. That exception is a reduced capacity in the pile foundation under the structure. Because of this permanent impairment, the current safe limit of differential head (headwater stage versus tailwater stage) that can be placed on the structure is 22 feet, as compared to 37 feet before the flood damages. This limitation does not hinder the normal operation of the low sill structure, but does cause concern about its ability to deal with emergency situations, which may cause higher than normal differential heads. While this deficiency cannot be remedied by direct action (repair of the damaged foundation), it can be dealt with effectively by the construction of an auxiliary structure, the existence of which will prevent differential heads from exceeding the safe limit. Construction of the auxiliary structure began in 1981 and will be completed in 1985. In the interim, the low sill structure is fully capable of dealing with all normal operational conditions, including major floods.

A.7.5. The low sill structure diverts a sizeable portion of the Mississippi River's flow and, during the years of operation, the deepest part of the Mississippi River at this point has progressively moved toward the low sill inflow channel. These factors may induce unwary or unattended river traffic to be "pulled" or "drawn" into the inflow channel and into the low sill structure. Loose barges were drawn into the structure in 1964 and 1965. The "draw" characteristic does not in itself place any operating constraints on the structure, but the possible consequences of another marine accident imply a grave threat to the structure, particularly with the present limitation on differential head (22 feet). Since the occurrence of these two accidents, a picket boat has been stationed near the junction of the inflow channel and the Mississippi River. The picket boat monitors traffic on the river, checks for unsafe conditions, and renders assistance to vessels in distress. A new and more powerful picket boat is currently being constructed to replace the one now on duty. To improve the ability to detect vessels further upstream and at night, a radar detection system, with a monitor on the picket boat, is currently being constructed. The planned auxiliary structure will reduce the threat to marine traffic.

TABLE A-7-3

REHABILITATION MEASURES - OLD RIVER COMPLEX

Rehabilitation Measure	Purpose	Status
Install additional piezometers		Construction complete
Gate leaf and structure modification	To allow either orifice or full gate closures	Construction complete
Outflow channel protection	To stabilize the outflow channel by providing additional riprap	Construction complete
Inflow channel protection	To stabilize the inflow channel and adjacent Mississippi River bank by providing additional riprap and revetment	Construction complete
Overbank structure modification	To provide capability to function under future hydraulic conditions	Construction in progress
Install riser pipe and pressure gages in drainage manholes		Construction complete
Construct spare gate leaves		Construction in progress
Install additional piezometers		Construction in progress

DETERIORATION OF MISSISSIPPI RIVER CHANNEL

A.7.6. Since construction and operation of the Old River control complex, the Mississippi River channel downstream between the complex and Morganza control structure has shown a marked decrease in channel capacity. This decrease is discussed in detail in DM No. 12. The requirement to maintain an adequate channel for flood control purposes in the Mississippi River below Old River complex also imposes limits within which the structure must be operated and, conversely, restricts the freedom to regulate flows into the Atchafalaya Basin Floodway system.

VARIOUS INTEREST GROUPS DESIRE TO CHANGE THE EXISTING FLOW REGULATION

A.7.7. In 1964 and 1965, loose barges were drawn into the Old River low sill structure and it had to be closed for barge salvage operations. While it was closed, water levels in the Red River backwater area dropped dramatically, and farmers became aware of the potential of the Old River project for reducing flows to enhance agricultural production. At public meetings held in late 1968, agricultural interests in the Red River backwater area requested that stages in the backwater area be regulated to low levels at the junction of the Red and Black Rivers as early as practicable during the growing season. At those same public meetings, environmental interests requested that additional flows be diverted through the structure to the Atchafalaya Basin during low water periods.

Atchafalaya Basin Floodway System

A.7.8. This area encompasses all the project within the guide levees, from the inlets down to the outlets. The area, and the features therein, have been described in detail in Section 4, of this Appendix. The problems and needs of this area are discussed in the following paragraphs.

INADEQUATE CONVEYANCE CAPACITY (LOWER FLOODWAY)

A.7.9. The flood conveyance capacity in the upper portion of the floodway system (i.e., West Atchafalaya Floodway, Morganza Floodway, and the leveed portion of the Atchafalaya River) is adequate for the design flows. However, below the latitude of Krotz Springs, the conveyance capacity becomes inadequate for design flood flows, with

the deficiencies generally increasing in magnitude toward the lower end of the floodway at about mile 100. The inadequate conveyance capacity is due to insufficient heights of the confining levees which, in turn, is due to a combination of several factors, as follows:

- The flow regime of the Atchafalaya River is rapidly changing as the river seeks to establish an equilibrium slope. The net effect is that flowlines in the upper basin are tending to lower while flowlines in the lower basin are tending to rise. These trends will continue, at a decreasing rate, until equilibrium is obtained.

- The main channel in the basin has not matured. This results in extensive overbank flows and sedimentation for medium and high river stages, leading to increases in flowlines as noted above.

- Overbank sedimentation, by increasing the land elevations within the floodway, acts to decrease the available flow capacity below a given elevation and to increase the flood stages. This phase of the problem is compounded by the lack of a mature main channel.

- The foundations upon which the guide levees (East and West Atchafalaya Basin Protection Levees) are constructed are extremely poor in the lower part of the floodway, resulting in severe settlement problems. As a result, it has been extremely difficult in some areas to construct and maintain the guide levees to the required grades.

RAPIDLY CHANGING BASIN ENVIRONMENT

A.7.10. The environment within the basin, in terms of water and land areas and types of predominant vegetation, is changing at a relatively rapid rate. This is largely due to the fact that the Atchafalaya River is a young river. It is actively seeking to develop a flood plain, an equilibrium slope, and a mature channel. The rate of environmental change is also attributed to the basin's periodic use as a floodway. It's changing flow regime in the basin together with extensive sedimentation continue to convert areas that were formerly open water or swamp to land. As land areas emerge and vegetate, they are cleared for more economically profitable use, such as soybean production. The conversion of open water and swamp to forestland, followed by conversion of forestland to cropland, has eliminated many of the wetland and forest areas that once existed in the basin north of I-10. This process of change continues in the southern basin, and will eventually result in elimination of much of the remaining swampland and privately-owned forestland. The conversion to cropland will cause a dramatic reduction in the ability of the project area to support significant populations of fish and wildlife.

ANTICIPATED NAVIGATION PROBLEMS

A.7.11. Although there are presently no problems with commercial or recreational navigation access, the changing water regime and sedimentation may cause such problems in the future if present maintenance activities are not continued.

INADEQUATE PUBLIC ACCESS

A.7.12. The Atchafalaya Basin offers vast potential for nonconsumptive recreation, as well as for hunting and fishing by the general public. At present, adequate public access facilities are limited, creating a need for the following activities: bicycling, tent camping, hiking, horseback riding, nature walks, picnicking, multi-use fields, multi-use courts, playgrounds, boating, fishing, and waterskiing.

OUTLETS OF THE FLOODWAY SYSTEM

A.7.13. This encompasses the two outlets of the floodway system (Wax Lake Outlet and the Lower Atchafalaya River), including the channels between the lower floodway and Atchafalaya Bay. The area, and the features therein, have been described in detail in Section 4 of this Appendix. The problems and needs of this area are as follows:

- The present combined conveyance capacity of the two outlets, through the Teche Ridge, is inadequate to convey the design flood flows. This is due to a combination of the following factors: The confining levees are of inadequate height; the distance between the levees is limited; that is, there is restricted overbank flow area; the overall capacity of the Wax Lake Outlet and Lower Atchafalaya River has decreased; and, there is no control for flow distribution between the two channels.

- The Berwick Bay has required dredging for navigation in the past due to shoaling.

LOWER ATCHAFALAYA RIVER BACKWATER COMPLEX

A.7.14. This area includes those lands extending from just south of Baton Rouge to the Gulf of Mexico, roughly bounded on the east by the Texas and New Orleans Railroad and the Houma Navigation Channel and on the west by the Lower Atchafalaya Basin Floodway.

A.7.15. The Avoca Island levee, an extension of the East Atchafalaya Basin Protection Levee, was built to limit project design flood stages in this area to generally the same as those which occurred in the 1945 flood. However, since construction of the levee and the Bayou Boeuf lock would change the Morgan City-Amelia area from one affected by headwater flow to one affected by backwater flow, the levee could not exactly reproduce the conditions of the 1945 flood. The 1945 flood stage at Morgan City was 6 feet NGVD in the Atchafalaya River and was about 4 feet NGVD between Morgan City and Gibson, and between Morgan City and Pierre Pass. For the project design flood discharge without the Avoca Island levee, the peak stage east of Morgan City, in the late 1940's, was computed to 4 feet NGVD. To achieve the required project flood stage east of Morgan City of 4 feet NGVD, the new levee south of Morgan City was alined parallel to the Atchafalaya River, extending about 13 miles south of the city, and terminating at a flowline elevation then estimated at about 7.5 feet. The degree of protection provided by the levee varied with the location elevation of the protected area. For all lands above elevation 4 feet NGVD, complete protection against a project flood was achieved. Lands below 4 feet NGVD, while overflowed, would be inundated to lesser depths and for shorter durations. The flood stage reduction would diminish with distance eastward from Morgan City toward Bayou Lafourche and northward toward Bayou Sorrel lock. Since the original design, deltaic activity below Morgan City has caused the stage at the end of the Avoca Island levee to rise by about 2 feet. As the delta continues to build, stages at the existing levee terminus would ultimately rise by more than 6 feet, compared with conditions of 1945. Despite rising stages, agricultural, residential, commercial, and industrial development has continued; however, long-term growth for this area is questionable in the absence of additional flood protection.

ATCHAFALAYA BAY

A.7.16. This area includes the Atchafalaya Bay and the adjacent marshlands. The principal need of this area is a comprehensive management plan for the existing and newly-forming marshlands, compatible with the required flood control and navigation features.

Section 8 - PLANNING CONSTRAINTS

A.8.1. As discussed in the previous section, the overwhelming planning constraint is that the project must be able to safely convey the project flood. Other constraints are inherent in the applicable laws and executive orders. These are as follows:

- Clean Water Act of 1977, 33 U.S.C. 1251 et seq. (Sec 404).
- Coastal Zone Management Act of 1972, as Amended, 16 U.S.C. 1451 et seq.
- Endangered Species Act of 1973, as Amended, 16 U.S.C. 1531 et seq.
- Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq.
- National Historic Preservation Act of 1966, as Amended, 16 U.S.C. 470 et seq.
- Archeological and Historic Preservation Act of 1974, as Amended, 16 U.S.C. 469 et seq.
- Estuary Protection Act.
- Federal Water Project Recreation Act.
- Land and Water Conservation Fund Act.
- Marine Protection Research and Sanctuaries Act of 1872, as Amended.
- EO 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971.
- EO 11988, Floodplain Management, 24 May 1977.
- EO 11990, Protection of Wetlands, 24 May 1977.
- Analysis of Impacts on Prime and Unique Farmlands in EIS, CEQ Memorandum, 30 August 1976.
- National Environmental Policy Act of 1969, as Amended, 42 U.S.C. 4321 et seq.
- EO 11514, Protection and Enhancement of Environmental Quality, 5 March 1970, as Amended by EO 11991, 24 May 1977.

- Clean Air Act, as Amended, 42 U.S.C. 7401 et seq.
- Principles and Standards.
- River and Harbor Act.
- Watershed Protection and Flood Prevention Act.
- Wild and Scenic Rivers Act.

Section 9 - PLANNING GOALS AND OBJECTIVES

A.9.1. Aside from the co-equal national objectives of environmental quality and national economic development, goals and objectives specific to the Atchafalaya Basin study were developed by the Agency Management Group. The primary goal is to develop, as soon as possible, an implementable multipurpose plan to protect south Louisiana from Mississippi River and tributaries floods while retaining and restoring the unique environmental features and long-term productivity of the natural environment of the basin.

A.9.2. Within this overall goal, specific objectives can be defined. Among these are:

- Flood Control--Implement a flood control system that will safely pass the project flood to the Gulf of Mexico in an environmentally sound manner. Reduce to the maximum extent practical the deposition of sediments that reduce the ability of the floodway to pass the project flood.

- Natural Environment--Retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands.

- Agricultural Activities and Mineral Development--Allow agricultural activities and mineral development, provided such activity does not interfere with the goals relative to flood control or the natural environment.

- Delta Formation--Maximize natural delta formation in Atchafalaya Bay while providing for navigation and passage of the project flood.

- Public Accessibility--Maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway.

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APPENDIX B

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

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Appendix B

FORMULATION, ASSESSMENT, AND EVALUATION OF DETAILED PLANS

B.0.1. The information presented in this appendix details the development of plan alternatives from formulation, through assessment and evaluation, to recommendation. It also augments the main report by describing the study process and coordination efforts, planning rationale, the decision-making process, requirements for mitigation, and other technical data to support analyses, decisions, or recommendations. A general map of the study area (Plate B-1) is included for reference.

Section 1 - THE STUDY PROCESS AND HISTORY

The Study Process

B.1.1. Studies conducted by the US Army Corps of Engineers normally follow a three-stage process in which the four functional planning tasks of problem identification, formulation of alternatives, impact assessment, and evaluation occur within the framework of each stage. Stage 1 studies are reconnaissance level, stage 2 involves development of intermediate plans, and stage 3 concludes the general investigation process with development of detailed plans (Federal Register, Vol. 43, No. 135-Thursday, July 13, 1978). Figure B-1-1 shows the relationship of plan development stages and functional planning tasks.

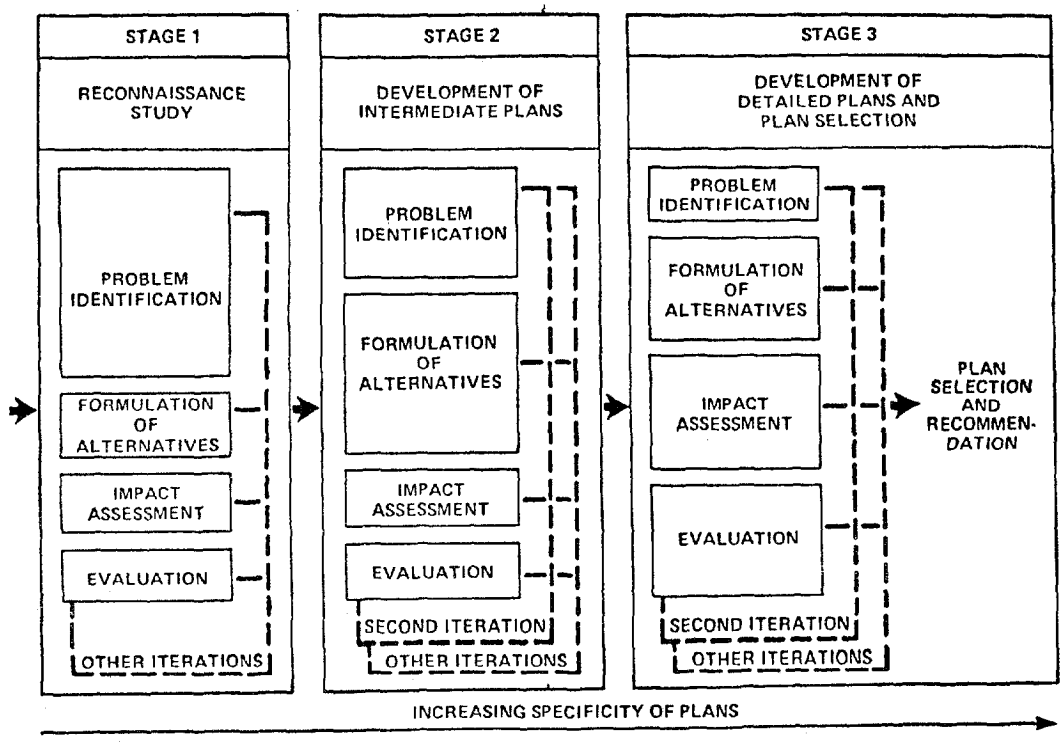

FIGURE B-1-1

PLAN DEVELOPMENT STAGES AND FUNCTIONAL PLANNING TASKS

B.1.2. In this study, however, the planning process was modified because of the extensive interagency and public involvement and the unusual combination of pre-authorization scope studies with post-authorization studies.

Study History

B.1.3. The study history portrays the progression of the public involvement influences and the subsequent effects on the planning process.

B.1.4. This study of the Atchafalaya Basin Floodway System was propagated by three congressional authorities:

- A 1968 resolution by the Committee on Public Works of the US Senate for a study of the operation of the Old River project

- Resolutions by both the US Senate and House of Representatives Committees on Public Works in 1972 for developing a comprehensive plan for the preservation and management of the water and land resources of the Atchafalaya Basin.

Authorities are stated verbatim in Appendix A.

B.1.5. In 1968, while implementing a previously authorized project feature, dredging the main channel, it was found that completion could not be effected because of a lack of funding. Subsequently, the work was blocked because there was no environmental impact statement (EIS) for the project. In 1971, the Chief of Engineers reached an agreement with the National Wildlife Federation (NWF) to cease dredging of the main channel until an EIS for the project was filed with the Council on Environmental Quality. In turn, the NWF agreed not to file any objection to work on other project features while the EIS was being prepared. Further, the NWF agreed to assist in the preparation of the EIS to bring an "environmental awareness" to the effort.

B.1.6. Throughout the course of the study, many informal meetings and field investigations were conducted for the purpose of fully coordinating with all interests; determining problems, needs, and opportunities; and assessing the impacts of alternate plans. In addition to these informal meetings, formal public meetings were held to determine the desires of local interests. Meetings were held in Morgan City, Louisiana, on 30 March 1950; Jonesville, Louisiana, on 2 October 1953; Monroe, Louisiana, on 19 April 1955; New Orleans, Louisiana, on 25 April 1955; Krotz Springs, Louisiana, on 26 April 1955; Plaquemine, Louisiana, on 6 September 1955; Port Allen,

Louisiana, on 7 November 1962; Morgan City, Louisiana, on 17 October 1964, and again on 28 September 1966; Vidalia, Louisiana, on 21 November 1968; Lafayette, Louisiana, on 19 December 1968; New Orleans, Louisiana, on 19 December 1968; Morgan City, Louisiana, on 15 October 1971; and Lafayette, Louisiana, on 25 January 1975. Generally, the comments received at these meetings were in favor of flood control both from protection and development potential standpoints. Requests stated the completion of authorized projects should be expedited. Sportsmen and environmentalists expressed that their purposes were not to oppose flood control but to protect and preserve fish, wildlife, and recreation resources.

B.1.7. In January 1972, a task force approach, in the form of a Steering Group, was initiated to manage studies for an EIS on the Atchafalaya Basin Floodway project. The Steering Group was chaired by the Corps of Engineers, with membership including representatives of the NWF; the Louisiana Department of Transportation and Development, Office of Public Works (OPW); the Louisiana Wildlife and Fisheries Commission; the US Department of the Interior, represented by the US Fish and Wildlife Service (USFWS); the US Environmental Protection Agency (EPA); and the Louisiana State University, School of Environmental Design. In 1974, a preliminary draft EIS was completed, and in January 1975, a public meeting was held to discuss the document. Following that meeting, the Steering Group developed a conceptual multipurpose plan for the Lower Atchafalaya Basin Floodway. No details were given on how the plan would or could be implemented. The Corps of Engineers began addressing the multipurpose plan under pre-authorization authorities while preparing the draft EIS for the Lower Atchafalaya Basin Floodway project in a separate effort. At this point, the studies were generally of reconnaissance scope and analagous to stage 1 study effort.

B.1.8. In February 1976, a draft EIS was completed and forwarded to the Office of the Secretary of the Army. Prior to public release, the Assistant Secretary of the Army for Civil Works, after meeting with national and local interests primarily concerned with conservation and wildlife, decided not to release the draft document. As a result of that decision, the Director of Civil Works of the Office of the Chief of Engineers (OCE) authorized post-authorization studies to address both the features of the floodway project and potential features for resource preservation and management. This directive, in effect, combined the studies.

B.1.9. The studies, having been combined, entered the intermediate planning stage with a reiteration of the four functional planning tasks under the management of the Agency Management Group. This group was headed by the District Engineer, New Orleans District, Corps of Engineers, and was comprised of the EPA, represented by both its Region VI office in Dallas, Texas, and the Environmental Monitoring and Support Laboratory in Las Vegas, Nevada; the US Department of the

Interior, represented by the USFWS offices in Lafayette, Louisiana, and Jackson, Mississippi; and the State of Louisiana, represented by the Department of Transportation and Development, OPW. The Corps of Engineers had the responsibility of coordinating the study; conducting engineering, socioeconomic, and environmental studies; consolidating information from other agencies and interested parties; and preparing the report. The USFWS conducted fish and wildlife studies, assisted in formulating alternative plans, and aided in assessment of the fish and wildlife impacts of the various alternatives in accordance with the Fish and Wildlife Coordination Act. The EPA conducted a number of hydrologic and hydraulic studies, assisted in formulating plans, and aided in assessment of the impacts of the alternatives on water quality. The State of Louisiana particiPted in all facets of the study and assisted in plan formulation. Other interests, including landowner representatives, hunting clubs, the National Marine Fisheries Service, and the NWF participated in the study in an advisory role. Group efforts emphasized the development of alternative features and the formulation of preliminary plans. In January 1979, these plans were presented to the public. Meetings were held in five Louisiana cities (Baton Rouge, Jonesville, New Orleans, Lafayette, and Morgan City) to present 10 comprehensive plans, developed by the Agency Management Group from a large array of alternative features, for public comment. Attendance at these meetings was more than 5,000. Afterwards, approximately 25,000 comments were received. The primary focus of those meetings was the issue of Federal acquisition of privately-owned lands in the Atchafalaya Basin Floodway for the establishment of the "Atchafalaya Fish, Wildlife, and Multi-Use Area," as proposed independently by the USFWS. On 27-28 March 1980, and again on 17 November 1980, representatives of environmental organizations, hunting clubs, the oil and gas industry, the League of Women Voters, public hunting organizations, landowner associations, sport fishing clubs, commercial fishing interests, agricultural interests, timber interests, and minority groups were invited to attend formal Agency Management Group meetings for the purpose of keeping their respective constituents informed about the status of Atchafalaya Basin study planning efforts. National level interagency meetings were held in Washington, DC, in November 1979, April 1980, and November 1980, for the purpose of discussing the status of studies on the Atchafalaya Basin. These meetings were attended by representatives of all Federal agencies having an interest in the studies. National officers of several environmental organizations also attended, along with State of Louisiana officials.

B.1.10. In a letter dated 5 November 1980, the Governor of Louisiana submitted land use recommendations for consideration in formulating the plans to be included in the draft report. A copy of this letter with inclosures is attached for reference at the end of this appendix.

B.1.11. The study then progressed through preparation of a draft report which was presented at a series of five public meetings in

July 1981. Subsequent sections of this appendix present results of the study effort, including the Tentatively Selected Plan presented at these meetings. Public reaction and some compromises among landowners, environmentalists, and the state, along with some changes due to refinement of analyses and data, have resulted in modification of the Tentatively Selected Plan. These modifications led to the formulation of the final Recommended Plan discussed in this report.

Section 2 - FORMULATION OF PRELIMINARY PLANS

B.2.1. The paramount result of any plan for the Atchafalaya Basin is that it must satisfy the preeminent purpose of flood control. However, since the basin is one of the largest river-overflow swamp ecosystems remaining in the United States, consideration must also be given to the preservation and enhancement of the natural resources existing there. A broad range of features was available to achieve the desired conditions, and a variety of public interests have been expressed regarding the future of the area. In order to address all the pertinent concerns, singular features that are responsive to individual problems, needs, and opportunities in the study area were proposed and combined with each other in various arrays to formulate plans for evaluation.

B.2.2. Management measures which satisfied either or both of the major study goals were proposed for consideration. Those options which address the flood control aspects of the study included measures to:

- Regulate the distribution of combined flows from the Red and Mississippi Rivers between the Mississippi and Atchafalaya Rivers with the Old River control structure
- Safely pass one-half the project flood through the Atchafalaya Basin Floodway system and its outlets to the Gulf of Mexico
- Reserve real estate interests required to preclude interference with floodway operation
- Control distribution and deposition of sediment
- Reduce damages east of the floodway due to backwater flooding from the Lower Atchafalaya River.

A no-action plan was contemplated; but because of the past commitment to the current floodway system, a true no-action plan is not feasible for the Atchafalaya Basin Floodway.

B.2.3. Management options weighed for dealing with environmental protection goals were:

- Minimization of environmental impacts of flood control features

- Utilization of management units to control water levels and circulation in hydrologically discrete, environmentally productive areas within the basin to propagate fish and wildlife resources

- Acquisition of real estate interests to protect and preserve fish and wildlife habitats and to improve public access

- Implementation of sediment control measures

- Effecting means suitable for protection of coastal marshes and enhancement of the delta-building process in Atchafalaya Bay

- No action.

Alternative Measures

B.2.4. Management measures previously discussed outlined the options possible for accomplishing the objectives set for the Atchafalaya Basin. These potential measures were categorized into groups of alternatives according to geographic area and/or function so that some basis for comparison of proposed actions could be established. The eight groups of measures to be studied were as follows:

- Group I - Alternatives for Operation of the Old River Control Structure

- Group II - Alternatives for Atchafalaya Basin Main Channel Development and Levee Raising

- Group III - Alternatives for Sediment Control

- Group IV - Management Units and Related Features

- Group V - Alternatives for Floodway Land Use

- Group VI - Alternatives for Floodway Outlets and Delta Building

- Group VII - Alternatives for Reducing Backwater Flooding Esat of Floodway

- Group VIII - Management Entity.

Specific features for effecting the objective results were explored for each of the major groups of management measures listed and are described in the following paragraphs of this section.

GROUP I - ALTERNATIVES FOR OPERATION OF OLD RIVER CONTROL STRUCTURE

B.2.5. Maintain a 70/30-Percent Distribution of Total Flows Between the Mississippi and Atchafalaya Rivers Below Old River, Respectively (Current Operation). This feature provides for operation of the Old River control structure to maintain the approximate distribution of flows between the Mississippi and Atchafalaya Rivers that was observed in 1950. The total flows of the Red River and the Mississippi River above the Old River project are distributed so that 70 percent of the combined flows moves via the Mississippi River below Old River and 30 percent moves via the Atchafalaya River. This flow distribution is currently maintained on an annual basis.

B.2.6. Maintain Current Operation with Provisions for Short Term Variation During May, June, and July. Various interest groups have expressed a desire for this distribution to be modified slightly. For example, farmers in the Red River backwater area would benefit during some years in the months of May, June, and July from a reduction of flow into the Atchafalaya River that would limit the stages at Acme, Louisiana, to 45 feet National Geodetic Vertical Datum (NGVD)[1/]. However, the USFWS would like flows increased during the same months in some drier years to benefit fishery resources in the lower floodway. Short term changes in flow distribution could be considered when such changes can be accomplished without adversely impacting other resource uses. Operational procedures would be reviewed to determine the advisability of developing specific criteria for such changes. The new auxiliary control structure at Old River (begun in July 1981) will serve to insure the integrity of the existing system and will maintain the existing operational conditions.

B.2.7. Operate Old River Control Structure to Keep Water Levels from Rising Above 35 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area. With this feature, flow through the Old River low sill control structure would be reduced as necessary to prevent stages on the Black River at Acme, Louisiana (in the Red River backwater area), from exceeding 35 feet NGVD. Two constraints preventing this stage from being maintained each year are the differential head between the forebay and the tailbay of the low sill control

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[1/] Unless noted otherwise, all elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD), formerly mean sea level.

structure cannot exceed 20 feet, and operation of the Morganza or Bonnet Carre floodways cannot be induced by the alternative. When stages on the Black River at Acme, Louisiana, are 35 feet NGVD or less, the 70/30 distribution of flows would be maintained.

B.2.8. Operate Old River Control Structure to Keep Water Levels from Rising above 40 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area. This feature is identical to the preceding one, except stages at Acme would be limited to 40 feet in lieu of 35 feet.

B.2.9. Operate Old River Control Structure to Keep Water Levels from Rising Above 45 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area. This feature is identical to the 30 feet at Acme option, except stages would be limited to 45 feet in lieu of 30 feet.

B.2.10. Operate Old River Control Structure to Maintain 35 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area with No Head Constraints. Under this proposal, flows through Old River control structure would be reduced as necessary to prevent stages on the Black River at Acme, Louisiana, from exceeding 35 feet NGVD. The differential head constraint at the low sill control structure would not be applicable because a new replacement structure would be installed. However, the constraint of not inducing an operation of the Morganza or Bonnet Carre floodways would still be appropriate. When stages on the Black River at Acme, Louisiana, are 35 feet NGVD or less, the 70/30 distribution of flows would be maintained.

B.2.11. Operate Old River Control Structure to Maintain 65/35-Percent Distribution of Total Flows Between the Mississippi River Below Old River and the Atchafalaya River, Respectively. In addition to the constraints described in previous paragraphs, this alternative feature would require flows in the Mississippi River below Old River be a minimum of 300,000 cubic feet per second (cfs) to limit the point of saltwater intrusion from the Gulf of Mexico to Head of Passes because of the impacts on drinking water supplies.

B.2.12. Operate Old River Control Structure to Maintain 60/40-Percent Distribution of Total Flows Between the Mississippi and Atchafalaya Rivers Below Old River, Respectively. Under this option, flows through the Old River control structure would be increased to maintain a 60/40-percent distribution between the Mississippi River below Old River and the Atchafalaya River, respectively. A new replacement structure would be required for normal flows. As with the previous feature, flows in the Mississippi River below Old River must be maintained above 300,000 cfs to minimize saltwater intrusion.

GROUP II - ALTERNATIVES FOR ATCHAFALAYA BASIN MAIN CHANNEL DEVELOPMENT AND LEVEE RAISING

B.2.13. Raise the Floodway Levees Only. The Atchafalaya Basin protection levees and associated structures would be raised to confine project floodflows, and no measures would be taken to further accelerate the development of the Atchafalaya Basin main channel. The construction of other authorized project features, exclusive of the Sherburne and Courtableau freshwater structures and the incomplete boat-launching ramps, would be continued. All subsequent options for main channel development recognize that the East and West Atchafalaya Basin Protection Levees will continue to be raised, as necessary, in combination with the main channel development feature, to safely pass the project flood. Also included in all structural plans is the installation of bank protection measures on the Atchafalaya River above river mile 55.

B.2.14. Dredge a 100,000-Square Foot (sf) Main Channel. With this feature the Atchafalaya Basin main channel would be dredged to accelerate its development to 100,000 sf below the 1963 datum plane between the head of Whiskey Bay Pilot Channel and Wax Lake Outlet (mile 54.5 to mile 105.0), and to 80,000 sf below the 1963 datum plane between Wax Lake Outlet and Stouts Pass (mile 105.0 to mile 112.3). Gaps would be left in the dredged material.

B.2.15. Dredge a Confined 100,000-sf Main Channel. This feature is the same as the preceding one, except that no gaps would be left in the dredged material.

B.2.16. Dredge an 80,000-sf Main Channel. Under this option, the Atchafalaya Basin main channel would be dredged to 80,000 sf below the 1963 datum plane between the head of Whiskey Bay Pilot Channel and Wax Lake Outlet (mile 54.5 to mile 105.0) and 60,000 sf between Wax Lake Outlet and Stouts Pass (mile 105.0 to mile 112.3).

B.2.17. Train the Main Channel. To effect this alternative feature, material would be dredged from the Atchafalaya Basin main channel and deposited within diked disposal areas on its banks to a height sufficient to confine average annual high water. Variations of this feature would confine only lesser floods within the banks of the main channel.

GROUP III - ALTERNATIVES FOR SEDIMENT CONTROL

B.2.18. Realine Distributary Channels. The realinement of the major distributary channels of the Atchafalaya Basin main channel would be made to effect a reduction in deposition of bedload sediments to the distributary. These realinements would be constructed at the major

distributary channels: the Old Atchafalaya River, the east and west access channels, and the east freshwater distribution channel. Any combination of these realinements could be combined with any one of the other groups of alternatives in a comprehensive plan.

B.2.19. Construct Distributary Sediment Traps. This proposal would provide sediment traps; i.e., enlarged channel sections to reduce flow velocities near the heads of major distributary channels. These enlargements would act as settling basins, thereby trapping sediments. The sediment traps would be maintained by annual dredging. Sediment traps could be constructed at any of the distributaries with or without distributary realinements and/or in conjunction with any one of the preceding groups of alternative features.

GROUP IV - MANAGEMENT UNITS AND RELATED FEATURES

B.2.20. Natural processes and human actions have combined to produce distinct environmental and hydrological subdivisions within the Lower Atchafalaya Basin Floodway. These areas have been identified as management units for the purposes of this study (see Figure B-2-1) so that it may be possible to formulate water management plans to retain or restore unique environmental values of an individual area. Engineering and environmental feasibility for effecting the desired conditions within each unit would be determined by subsequent detailed studies. Proposed actions would achieve the following:

- Restoration of water regimes to approximate, as closely as practicable, historical overflow patterns
- Regulation of water circulation through the units to benefit specific habitats of the unit
- Restriction of sediment movement and deposition within the units
- Continued transportation of nutrients and organic matter to estuarine areas and the Gulf of Mexico.

B.2.21. Each management unit would be individually evaluated to determine the potential for successfully retaining or restoring desirable environmental values. Some preliminary proposals investigated early in the study process are described in Appendix C.

B.2.22. Alternatives to Management Unit Plans. An alternative to each of the management unit concepts described in Appendix C was a plan by which each unit would have controlled inlets and outlets, lock, and pumping stations. These alternatives were eliminated from further consideration because preliminary estimates indicated that

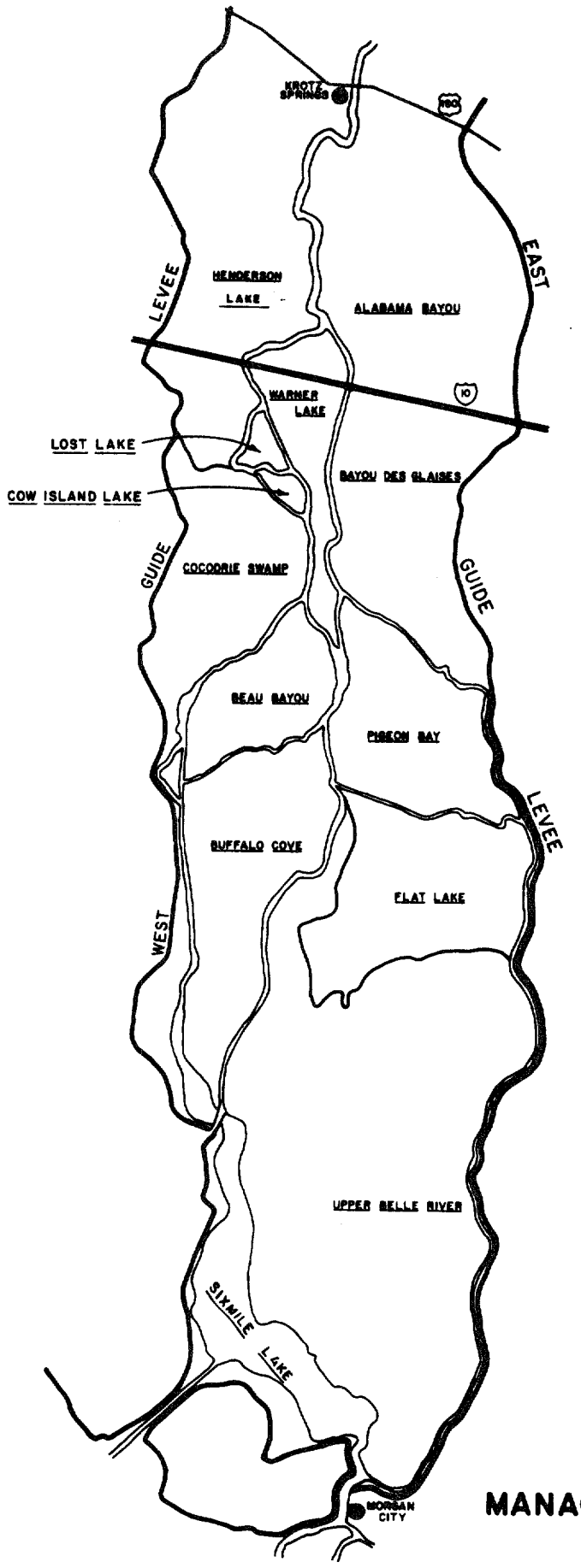

FIGURE B-2-1

MANAGEMENT UNITS

construction, operation and maintenance costs would be far greater than with other alternatives.

B.2.23. Freshwater Structures. The Courtableau Freshwater Diversion Structure to be placed at Atchafalaya River mile 48 would serve as an inlet through the river levee for the Henderson Lake management unit area. This structure would be a gated culvert designed to pass 3,000 cfs into Bayou Courtableau. The Sherburne Freshwater Diversion Structure at river mile 43 would provide freshwater through the river levee to the Alabama Bayou area. This gated culvert would pass 3,000 cfs into Big Alabama Bayou.

B.2.24. Canal Closures and Circulation Improvements. This feature would consist of closing certain canals that permit sediment-laden waters to enter backswamp areas and of improving water circulation throughout the lower floodway by selective opening of dredged material banks and other features that presently impede beneficial circulation.

GROUP V - ALTERNATIVES FOR FLOODWAY LAND USE

B.2.25. No Action. No additional real estate interests would be acquired.

B.2.26. Fee Acquisition. The Federal Government would purchase all surface rights to all lands in private ownership in the Lower Atchafalaya Basin Floodway below the approximate latitude of Krotz Springs, Louisiana.

B.2.27. Comprehensive Multipurpose Easement: Government Controls Timber and Access. This easement would allow the Federal Government to overflow lands in the Lower Atchafalaya Basin Floodway for any purpose, for any length of time, either naturally or artificially; to construct recreational facilities; to regulate public access; to forbid construction of permanently habitable structures; to forbid or regulate the construction of other structures, including camps; to forbid removal of timber; to forbid the use of lands for agricultural purposes; and to regulate excavation and landfill operations. Landowners would retain mineral rights. These easements would be acquired over all lands in private ownership within the Lower Atchafalaya Basin Floodway below the approximate latitude of Krotz Springs.

B.2.28. Comprehensive Easement: Landowner Controls Timber, Government Controls Access. This interest would be similar to the preceding feature, except the landowner could pursue good commercial timber practice on a sustained yield basis.

B.2.29. Comprehensive Easement: Landowner Controls Timber and Access. This would be similar to the preceding options, except the landowner would also control access.

B.2.30. In addition to the easement interests cited, several combinations of the individual features of these alternatives were evaluated.

GROUP VI - ALTERNATIVES FOR FLOODWAY OUTLETS AND DELTA BUILDING

B.2.31. Construct Levees Only. Levees, floodwalls, and other associated structures would be raised to confine project floodflows to the Lower Atchafalaya River and Wax Lake Outlet. The combined capacity of the floodway outlets to pass floodflows would be allowed to continue to decrease.

B.2.32. Construct a New Floodway Outlet Near Charenton. A new overbank floodway outlet would be constructed near Charenton, Louisiana, to provide additional capacity for floodflows. The design capacity of the overbank floodway outlet would be 250,000 cfs. The frequency of operation would average once each 50 years. A gated control structure would control inflows to the outlet. Other associated structures would provide for drainage intercepted by the new levees. Levees, floodwalls, and other associated structures would be raised to confine remaining floodflows to the Lower Atchafalaya River and Wax Lake Outlet. Back levees along Bayou Teche would be raised to prevent backwater flooding.

B.2.33. Widen Wax Lake Outlet Overbank. A new levee would be constructed west of the levee along the west side of Wax Lake Outlet near the Bayou Sale ridge to form a new overbank floodway outlet. The existing levee would be degraded to ground level. The added overbank area would increase the share of project floodflows passing through the Wax Lake Outlet. Levees, floodwalls, and other associated structures would be raised to confine remaining flows to the Lower Atchafalaya River and Wax Lake Outlet.

B.2.34. Construct a New Overbank Outlet East of the Floodway. This proposal would provide for a new overbank floodway outlet, extending from the East Atchafalaya Basin Protection Levee immediately north of Morgan City, Louisiana, across the Bayou Boeuf ridge to the Atchafalaya Bay. The design capacity of the new outlet would be 250,000 cfs; the frequency of operation would average once every 50 years. Canals and associated structures would provide for intercepted drainage when the floodway is in operation. Levees, floodwalls, and other associated structures would be raised to confine remaining outlet floodflows to Wax Lake Outlet and the Lower Atchafalaya River.

B.2.35. Redistribute Major Flows to Wax Lake Outlet. To accomplish this proposal, Wax Lake Outlet would be enlarged by dredging to increase its flow capacity, and a navigation lock and control structure would be constructed upstream of the Lower Atchafalaya River. Levees, floodwalls, and associated structures would be raised

to confine floodflows to the Lower Atchafalaya River and Wax Lake Outlet. Back levees along the Bayou Sale ridge would be raised to prevent backwater flooding.

B.2.36. Close Wax Lake Outlet to Normal Flows. A closure of the existing Wax Lake channel and a low-level levee would be constructed upstream of Wax Lake Outlet to close the outlet to normal flows. The low-level levee would act as a weir and would be overtopped on the average of once every 10 years. Levees, floodwalls, and associated structures would be raised to confine project floodflows to the Lower Atchafalaya River and Wax Lake Outlet.

B.2.37. Maintain Existing Flow Distribution. A weir and low-lying levee would be constructed upstream of Wax Lake Outlet to maintain approximately the existing distribution of flows, 70 percent to the Lower Atchafalaya River and 30 percent to Wax Lake Outlet. The weir would operate at all times and the low-level levee would be overtopped as described in the preceding feature. Levees, floodwalls, and associated structures would be raised to confine project floodflows to the outlets.

B.2.38. Restore Approved Design Flow Distribution. This feature is similar to that described in the preceding paragraph, except that the weir and low-lying levee could be designed to restore the distribution of flows between the two outlets that Wax Lake Outlet was designed for, i.e., 80 percent to the Lower Atchafalaya River and 20 percent to Wax Lake Outlet. Levees, floodwalls, and associated structures would be raised to confine project floodflows to the two outlets.

B.2.39. Construct Channel Training Works Below Morgan City. Channel training could be accomplished by closing Bayou Shaffer, a distributary of the Atchafalaya River, with an earthen dam. The development of the banks of the Lower Atchafalaya River and Wax Lake Outlet channel would be accelerated by dredging channel bottoms and using the material to construct shallow mounds designed to simulate the development of natural levees. Other distributaries would not be closed.

GROUP VII - ALTERNATIVES TO REDUCE BACKWATER FLOODING EAST OF THE FLOODWAY

B.2.40. The backwater area is delineated on Plate B-2.

B.2.41. Construct Bayou Boeuf Levee - Morgan City to Houma. With this plan, a new levee would be constructed from the Bayou Boeuf lock along Bayou Boeuf and Bayou Black, a distance of approximately 30 miles. Navigable floodgates would be provided where the levee crossed Bayous Boeuf and Black. Pumping facilities would be provided to remove all intercepted natural drainage from the backwater area.

B.2.42. Limited Structural Measures. These alternatives for protection of only the developed parts of the backwater area east of the floodway would consist of construction of ring levees and drainage pumping stations. One option would use two ring levees to protect the Morgan City-Amelia and Bayou Black industrial areas. Navigation structures in Bayou Chene just below Bayou Boeuf, on Bayou Boeuf just below Lake Palourde, and two on Bayou Black would be required. These structures would be closed when water elevations begin flooding the area. To provide for drainage of the runoff from the backwater area above Morgan City, a bypass east of and equivalent in size to Bayou Boeuf would be required. A second proposal would use 28 ring levees with pumping stations for interior drainage to protect the same industrial areas, as well as various populated areas within the backwater area (Plates B-3, B-4, and B-5). Such ring levees would provide protection within the ringed areas from backwater flooding, as well as headwater and tidal flooding. However, the construction right-of-way for ring levee alinements would require the relocation of about 1,900 existing residential, commercial, and public structures that are located along bayous or in other physically restricted areas. Further, all structures located outside the ring levees would require raising, flood-proofing, or removal for prevention of flood damages. Additionally, this alternative would not offer protection for roads nor most existing farmlands that are subject to backwater flooding.

B.2.43. Extension of Avoca Island Levee. The Avoca Island levee would be incrementally extended to a total length of either 17.0 or 19.6 miles, depending upon the levee alinement selected (see Plate B-6). The existing Avoca Island levee was constructed to limit project flood stages east of Morgan City to generally the same stages that occurred in that area in the 1945 flood. The amount of flooding from backwater is related to the stage in the Lower Atchafalaya River at the end of the Avoca Island levee. Since the active development of the delta in Atchafalaya Bay will result in elongation of the course of the river and raise the stage at the end of the existing levee for a given discharge, flooding in the backwater area would occur more frequently in the future. Depths of floodwater would also increase as time goes on. Thus, this feature would provide phased implementation of additional levee reaches as necessary to maintain stages for each reach equivalent to the 1945 backwater conditions. Two alinements were proposed for the levee extension, one following the navigation channel through Atchafalaya Bay and the other basically paralleling the eastern shore of the bay. Levee extensions would be accompanied by extensions of the Avoca Island cutoff channel around the end of each reach to provide for navigation. The bayshore alinement, totaling 19.6 miles in length, would require some type of navigation structure in the levee, since it would be infeasible to extend the cutoff channel around the end of the levee and across the bay to the Lower Atchafalaya River channel for each reach of the levee extension. Because the marsh in Terrebonne Parish east of the Avoca Island levee depends upon freshwater and sediment from the Lower

Atchafalaya River to prevent saltwater intrusion and compensate for marsh subsidence, a freshwater diversion structure or structures would be included in the levee extension to divert flow from the river to the marshes. The structure(s) would be designed to maintain the present distribution of flow, estimated to be 4,000 cfs, into the west Terrebonne Parish marsh and would be closed when the stage at Amelia, Louisiana, reaches 3.0 feet NGVD to provide protection from Lower Atchafalaya River backwater.

B.2.44. Extension of Avoca Island Levee 14,000 Feet. The Avoca Island levee would be extended by 14,000 feet to continue backwater flooding protection in the area east of the floodway for a period of about 10 years. This action would provide an interim period of protection to allow for completion of detailed studies of the Atchafalaya Bay-Terrebonne Parish marsh-backwater complex. A freshwater diversion structure, identical in both design and operation to that described under Extention of Avoca Island Levee, would also be provided for this interim protection alternative.

GROUP VIII - MANAGEMENT ENTITY

B.2.45. Management Entity. To insure the proper implementation and operation of the plan selected, a management entity comprised of the Corps of Engineers, USFWS, EPA, and the State of Louisiana would be established. Mechanisms would be included for public involvement. Emergency flood control operations would be conducted as required by the Corps of Engineers, with or without the concurrence of the management group.

Plan Formulation

B.2.46. As each of these major groups of alternative measures was, to some extent, interrelated with each of the other groups, an extremely large number of combinations of alternative features was possible. Since survey scope evaluation of the economic, environmental, and social aspects of each possible combination was impracticable, it was necessary to limit the number of combinations of alternative features to be considered. Thus, a number of plans, which were deemed representative of the spectrum of actions being studied, were selected and analyzed with respect to their relative economic and environmental benefits and anticipated adverse impacts. The results of these analyses, presented in subsequent paragraphs, and the inputs from the January 1979 public meetings provided a basis for eliminating a number of alternative features.

B.2.47. Analysis of the preliminary plans presented at the 1979 public meetings began with a compilation of existing data, including land and water use inventories, biological inventories, hydraulic and hydrologic data for present and alternate future conditions, and engineering cost estimates. Using these data and methods for predicting vegetative succession developed by an interagency interdisciplinary group of biologists, forestry experts, agricultural economists, and engineers, land use changes were estimated at 10-year increments for the period 1978-2029. To provide a common base for evaluation, all projections assumed immediate project implementation.

B.2.48. Except for conversion of bottomland hardwoods to cleared land, all other land changes in the Red River backwater area, upper floodways, and areas outside the floodway system were assumed to be constant for all plans. Hydrologic changes were assumed to occur at a constant rate (straight line) over the project life. Monetary and nonmonetary benefits and losses associated with the changes in land use resulting from each of the plans were determined by land type over time. Monetary values included commercial finfishing, commercial crustucean production, commercial fur trapping, timber resources, recreation resources, and agricultural production. Commercial fishing and fur trapping production was estimated by using the "1971-1974 Atchafalaya Basin Usage Study," prepared cooperatively by the New Orleans District and Louisiana Department of Wildlife and Fisheries. Values were assigned to the production figures by using National Marine Fisheries Service data. Recreation values were assessed by first determining demand. After consultation with the Heritage Conservation and Recreation Service (formerly Bureau of Outdoor Recreation), demand was established jointly by New Orleans District and State of Louisiana, Department of Culture, Recreation and Tourism, Office of Program Development recreation planners. Land use projections were used to determine supply. "Principles and Standards" values were assigned to the computed man-day deficits. Timber and agricultural values were determined from field investigations performed by New Orleans District economists. Finally, all values were adjusted to present value, using an interest rate of 6 7/8 percent, and amortized over the life of the project so that all data were based on average annual equivalents.

B.2.49. The nonmonetary analyses consisted of using habitat values previously determined by New Orleans District, USFWS, and Louisiana Department of Wildlife and Fisheries biologists for the USFWS Habitat Evaluation Procedure (HEP). A method similar to HEP was used to determine average annual habitat value differences associated with the various plans.

B.2.50. The discussion that follows reflects relative differences in plans. These differences were assumed to result from conversion of bottomland hardwoods, and direct land use changes resulting from project works.

EVALUATION OF OLD RIVER ALTERNATIVES

B.2.51. Information on the evaluation of the national economic development (NED) and the environmental quality (EQ) components of the alternative plans for operating the Old River, Louisiana, project is summarized below. The modification of the operation of the Old River, Louisiana, project to redistribute flows between the Mississippi River and the Atchafalaya River, and the direct and indirect physical changes that would be effected by such redistributions would have significant economic and environmental impacts throughout the study area. The cost of completing the Mississippi River mainline levees below Old River and the cost of completing the Atchafalaya Basin Floodway project would be significantly affected. In some cases the cost of modifying the Old River project to accommodate the modified flow distribution would be significant. Development (mostly agriculture) in the Red River backwater area and the Lower Atchafalaya Basin Floodway would be affected, as would fish and wildlife resources and recreation. Commercial fishing and trapping in the Lower Atchafalaya Basin Floodway would be affected by some of the alternatives. These effects are discussed subsequently in more detail.

B.2.52. NED Effects on the Mississippi River Mainline Levees. The mainline Mississippi River levees below Old River have not been completed to the project flood grade. If average annual flows in the Mississippi River below Old River were increased, scouring of the Mississippi channel would occur, effecting an increase in the bankful capacity of the river and a corresponding drop in the project flood flowline. For a decrease in average annual flows, the Mississippi River channel would fill in and the project flood flowline would rise. Because of the time frame during which scouring of the Mississippi River channel would occur, interim protection would be provided to the present project flowline. Additional costs of completing the Mississippi River levees would be incurred only if more than 30 percent of the flows were passed down the Atchafalaya.

B.2.53. NED Effects in the Atchafalaya Basin Floodway. The redistribution of average annual flows between the Mississippi and Atchafalaya Rivers would also affect the rate of development and the ultimate size of the Atchafalaya River and its main channel. The flood-carrying capacity of the Atchafalaya Basin main channel would be increased by those alternatives that increase average annual flows to the Atchafalaya River and would be decreased by those alternatives that decrease flows to the Atchafalaya River. A corresponding change in project flood flowlines for the Atchafalaya Basin Floodway would be effected. Thus, in terms of costs to complete the Atchafalaya Basin Floodway project, the Old River alternatives that reduced flow down the Atchafalaya showed slightly higher costs than a 70/30 distribution. Alternatives that increased the percentage of flows down the Atchafalaya were substantially cheaper than the 70/30 distribution.

* B.2.54. NED Effects on Old River Project. To provide redistribution of flows proposed by some alternatives considered at Old River, structure modifications or replacement would have been required. For example, a replacement structure, costing an estimated $220 million in
* 1978, would be necessary had the 35 feet NGVD at Acme (No Head Restriction) or the 60/40-Percent Distribution alternatives been recommended. However, the auxiliary structure (currently under construction) satisfies the requirements of the other Old River alternatives at a cost lower than the replacement structure; and
* therefore, significant savings were realized.

B.2.55. NED Effects on Development in Red River Backwater Area and Atchafalaya Basin Floodway. A change in operation of the Old River project would affect the overflow regime in the Red River backwater area. If less water were passed down the Atchafalaya River, less flood damages to agriculture and other development would occur, the agricultural yields from cleared lands and the amount of land that could be converted from woodland to agriculture would increase substantially. On the other hand, plans that would increase flows through Old River would cause substantial agricultural losses compared to a 70/30 distribution.

B.2.56. The 35-, 40-, and 45-foot at Acme plans would result in greater agricultural development within the Lower Atchafalaya Basin Floodway; however, they would also cause substantial fish and wildlife losses. Generally, the 65/35 distribution plans would result in short term gains for fish and wildlife values, but would result in a net loss over the project life. This is because these alternatives for Old River operation would cause a greater amount of main channel development over the long term.

B.2.57. EQ Effects on the Mississippi Mainline Levee. Small additional acreage would be required to raise the levees if more water were passed through Old River. The majority of the acreage required would be existing levee; however, a small amount would be early successional bottomland hardwoods.

B.2.58. EQ Effects on the Lower Atchafalaya Basin Floodway. Compared to maintaining a 70/30 flow, the reduction in water levels caused by the 35 feet at Acme plan would drastically reduce wildlife habitat. An average of approximately 4,000 acres would be lost each year. Large amounts of fishery habitat would also be destroyed annually.

B.2.59. It should be noted that the 65/35 plan would cause a short term rise in water levels but an ultimate drop in water levels and an increase in sedimentation over the 70/30 plan.

B.2.60. EQ Effects in Old River Project. An auxiliary structure at Old River would be necessary for all alternatives except the 35 Feet NGVD at Acme (No Head Restriction) and 60/40-Percent Distribution alternatives, which would require a replacement structure instead. The direct land and water requirements for these alternatives were not calculated but were estimated to be essentially the same.

B.2.61. EQ Effects in the Red River Backwater Area. Changes in operation of the Old River project would affect the amount of land clearing that would occur in the Red River backwater area. The 35 Feet at Acme plan would cause a certain, uncalculated loss in aquatic habitat, while the 65/35 plan would preserve more aquatic habitat in the backwater area. The loss in terrestrial habitat for the 35 Feet at Acme plan would be substantial with extensive acreage being cleared each year for agricultural production.

EVALUATION OF ATCHAFALAYA BASIN MAIN CHANNEL DEVELOPMENT ALTERNATIVES

B.2.62. Information on the evaluation of the NED and the EQ components of the plans for providing project floodflow capacity in the Lower Atchafalaya Basin Floodway is summarized in the following paragraphs. Only those related to the Atchafalaya Basin main channel plans are presented here. Others will be presented later.

B.2.63. The most significant economic effects of the alternatives for providing project floodflow capacity in the floodway relate to the cost of completing the Atchafalaya Basin Floodway project. Commercial fishing and trapping, recreation, and timber resources would also be affected. The effects are discussed below.

B.2.64. NED Effects on Atchafalaya Basin Floodway Project. Measures to accelerate the development of the Atchafalaya Basin main channel would also effect a reduction in sedimentation. The difference is in the amount of sedimentation that would occur while the main channel is developing. For the purpose of evaluating the effects of each of the feature options for developing the main channel, four alternative combination flowlines were run and costs analyzed. These were for the 100,000-sf main channel, the 80,000-sf main channel, channel training on the main channel, and levees only. For comparing each of these schemes, both the Old River distribution and the outlets distribution were taken to be 70/30. This group of alternatives demonstrated the relationship between the cost of raising levees, floodwalls, and other structures to confine project floodflows and the cost of acceleration of main channel development. Preliminary cost estimates indicated that the 80,000-sf channel alternative would have the highest first costs because of the higher flowline and associated levee raising costs.

B.2.65. Other NED Considerations. The main channel alternatives also effect a redistribution in habitat types by affecting the ultimate amount of sedimentation that will occur in the floodway overbank areas and the suitability of the land for development. This, in turn, would affect commercial fishing and trapping, recreation, timber, and agricultural resources in the floodway. Preliminary estimates indicated that, compared to levee raising, channel training would reduce recrea-

tional, commercial fishing and trapping, and timber revenues, but would at the same time slightly increase agricultural revenues. The 100,000-sf channel would double the above losses. Agricultural revenues would be six times those with channel training but would not equal the environmental losses.

B.2.66. EQ Effects on Atchafalaya Basin Floodway Project. Preliminary estimates indicated that 16,000 acres of forestland would be necessary for channel training and in excess of 20,000 acres for the 100,000-sf channel. Habitat values in the future would decrease drastically with the 100,000-sf channel due to the clearing for agriculture that would occur with this plan.

EVALUATION OF FLOODWAY LAND USE PLANS

B.2.67. NED Considerations. The primary NED effect would be the cost of acquiring easements. The acquisition of floodway lands or multipurpose easements could prohibit clearing of forestland for agricultural purposes, and the net yield from timber production would increase while agricultural yields would be reduced. The clearing restriction would increase the values for recreation and commercial fishing and trapping, and preserve more areas for these uses. The yearly agricultural losses due to easements would be four times greater than environmental gains.

B.2.68. EQ Considerations. Acquisition of floodway lands or multipurpose easements could preserve thousands of acres of fish and wildlife habitat that would otherwise be lost due to clearing for agriculture.

EVALUATION OF FLOODWAY OUTLETS PLANS

B.2.69. Information on the alternative plans for passing floodflows from the Lower Atchafalaya Basin Floodway are discussed below. These plans have significant effects on the cost of completing the Atchafalaya Basin Floodway project. Associated with some of the plans is a redistribution of project floodflows and normal flows. These would impact on environmental and economic values of the area affected by outflows from the floodway, primarily the marsh areas near the outlets. The configuration of the new delta would also be affected by some alternatives, although the ultimate size and area-elevation relationship of the new land mass would not be significantly affected. These impacts are discussed as follows.

B.2.70. NED Effects of Outlet Plans. The outlet alternatives have a significant effect on the cost of completing the Atchafalaya Basin

Floodway. Associated with each alternative is the cost of its implementation and the savings in levee and floodwall cost. The least costly outlet alternative would be to maintain the existing 70/30 distribution, widen the Wax Lake Outlet overbank, and channel train the outlets. The most expensive alternative would be the floodway east of the channel.

B.2.71. EQ Effects of Outlet Plans. The alternative outlet plans for the floodway affect the direct land and water requirements for the completion of existing project features (by causing flowline changes) and require land and water areas for their construction. The net requirements of wetlands and total land and water varied greatly. These alternatives also affect the distribution of flows between the Lower Atchafalaya River and Wax Lake Outlet.

January 1979 Public Meetings

B.2.72. Combined with the foregoing appraisal of the effects of proposed actions, analyses of the plans developed for and the results obtained at the January 1979 public meetings provided the basis for the formulation of plans to be considered in detail. For illustrative purposes in connection with the public meetings, 10 "comprehensive plans" were assembled, each including one feature from each of the eight groups of alternatives previously discussed, to demonstrate to the public the wide array of plans that could be developed by combining features from the various groups. Plans presented gave varying degrees of emphasis to each of the goals and objectives of the study, ranging from those which were primarily for environmental protection to those which stressed economic development. An underlying constraint on the formulation of all plans was the need to provide protection from Mississippi River flooding.

B.2.73. In addition to the real estate options developed in earlier study efforts, the USFWS, in October 1978, published a brochure entitled, "The Atchafalaya, America's Greatest River Swamp," proposing the establishment of an Atchafalaya Fish, Wildlife, and Multi-Use Area. The major element of the proposal would be the purchase by the Federal Government of 445,000 acres of privately-owned land in the basin. Under their plan, the current landowners would retain the mineral rights. Management of the area acquired would be the responsibility of the US Department of the Interior and the Louisiana Department of Wildlife and Fisheries. The primary management objectives would be the preservation of the wetland character of the floodway and the guarantee of full public enjoyment of its fish, wildlife, and recreational resources. Continued use of existing camps

and dwellings would be allowed along perimeter levees and presently developed natural ridges.

Comparison of Preliminary Plans

B.2.74. The 10 preliminary plans developed for discussion at the January 1979 public meetings are shown in Table B-2-1. To evaluate and compare the plans, they were ranked from 1 through 10 according to their estimated impact on various environmental, physical, and economic factors as understood at that time. The results of that ranking are shown in Table B-2-2.

B.2.75. The following is a brief description of the impacts of each plan; these impacts were used to rank the plans by impact category. The main factors affecting the rankings were land use control, sediment controls, water levels, and direct construction requirements. Rankings were based on the relative magnitude/value of the resource usage evaluated over the project life.

B.2.76. Summary of Impacts. Major impacts of each plan are summarized as follows.

B.2.77. Plan A. This plan would significantly increase flows into the Atchafalaya Basin and the Red River backwater area. Increased flows, in combination with Federal acquisition of the basin, would insure maximum preservation of the land- and water-oriented environmental values and would provide the general public an opportunity to enjoy these benefits. In particular, commercial crawfishing, sport and commercial fishing, and trapping would be enhanced by implementation of this plan more than by any other.

B.2.78. Conversely, reducing Mississippi River flows below Old River would adversely affect navigation on the Mississippi River. The increased stages in the Red River backwater area would considerably reduce agricultural production. Similarly, increasing flows into the Atchafalaya Basin, in combination with fee acquisition, would eliminate further agricultural clearing and remove the potential income that could be realized from this activity.

B.2.79. Management units as perceived at this stage of planning would provide for optimum environmental benefits.

B.2.80. The developed area east of Morgan City would be provided with flood protection; however, undeveloped areas would continue to be subject to flooding, limiting future development potential.

TABLE B-2-1 -DESCRIPTION OF PLAN FEATURES

PLAN	GROUP I - OLD RIVER CONTROL	GROUP II - MAIN CHANNEL	GROUP III - SEDIMENT CONTROL	GROUP IV - MANAGEMENT UNITS	GROUP V - FLOODWAY REAL ESTATE PLANS	GROUP VI - FLOODWAY OUTLETS AND DELTA BUILDING	GROUP VII - BACKWATER FLOODING	GROUP VIII - MANAGEMENT ENTITY
A	60 percent Mississippi River 40 percent Atchafalaya River	Channel Training	Yes	Yes	Fee Acquisition by Government	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent with sediment distribution	Limited structural measures	Yes
B	70 percent Mississippi River 30 percent Atchafalaya River	100,000 square feet	Yes	No	Comprehensive easement Government timber and access	Lower Atchafalaya River-0 percent/Wax Lake Outlet-100 percent	Limited structural measures	Yes
C	35 feet NGVD at Acme No Head Constraint	100,000 square feet	No	No	None	Lower Atchafalaya River-100 percent/Wax Lake Outlet-0 percent	Avoca Island Levee	No
D	70 percent Mississippi River 30 percent Atchafalaya River	Channel Training	Yes	Yes	Fee Acquisition by Government	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent with sediment redistribution	Limited structural measures	Yes
E	35 feet NGVD at Acme	100,000 square feet	Yes	No	Comprehensive easement landowner timber and access	Widen Wax Lake Outlet overbank Channel Training, Lower Atchafalaya River-100 percent/Wax Lake Outlet-0 percent	Avoca Island Levee	No
F	70 percent Mississippi River 30 percent Atchafalaya River	Confined 100,000 square feet	Yes	Yes	Comprehensive easement landowner timber Government access	Lower Atchafalaya River-100 percent/Wax Lake Outlet-0 percent, Widen Wax Lake Outlet overbank Channel Training	Avoca Island Levee	Yes
G	70 percent Mississippi River 30 percent Atchafalaya River	Channel Training	Yes	No	None	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent	Limited structural measures	No
H	70 percent Mississippi River 30 percent Atchafalaya River	100,000 square feet	No	No	None	Lower Atchafalaya River-80 percent/Wax Lake Outlet-20 percent	Avoca Island Levee	No
I	70 percent Mississippi River 30 percent Atchafalaya River	No action	No	No	None	No action	No action	No
J	70 percent Mississippi River 30 percent Atchafalaya River	Channel Training	Yes	Yes	Comprehensive easement Government timber and access	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent with sediment redistribution	Limited structural measures	Yes

TABLE B-2-2 --COMPARISON OF PLANS

Plan	Forest	Cleared Land	Water	Delta and Marsh	Land Inundated: Average of 0-4 months	Land Inundated: Average of 7 months	Accessibility to public	Crawfishing, trapping, fishing (sport and commercial), waterfowls and water quality	General recreation	Hunting	Deer, squirrels, and songbirds	Agriculture production	Timber production	Mississippi River Navigation	First cost (million $)	Annual cost (million $)
A	10	1	10	10	10	10	yes	10	10	6	5	1	7	2	775	65.3
B	9	2	6	9	6	6	yes	6	9	10	10	5	2	10	1,329	104.8
C	1	10	1	1	1	1	no	1	1	1	1	10	3	2	1,054	83.5
D	9	4	9	9	9	9	yes	9	9	10	8	4	8	10	937	76.8
E	5	6	4	2	2	2	no	2	5	5	9	9	10	3	735	62.5
F	6	5	9	5	9	9	yes	9	9	10	8	4	9	10	765	64.6
G	2	9	6	9	6	6	no	5	4	4	3	8	6	10	798	66.9
H	4	8	3	3	3	4	no	4	4	4	3	8	6	10	842	68.4
I	4	8	3	4	6	4	no	4	4	4	4	8	6	10	1,052	83.3
J	9	4	9	9	9	9	yes	9	9	10	8	4	2	10	912	75.1

Note: This table uses number rankings to compare plans A through J. In these rankings, 10 is the best. The numbers are used to show how plans compare to one another. As an example, for Forest, Plan A is ranked 10 (best) and Plans B, D, and J are ranked 9 (next best). This does not mean that Plans B, D, and J have 90 percent of the value for Forest of Plan A; it merely means they are ranked equally just below Plan A. The next highest ranked plan is Plan F_1 which is ranked 6. This means four plans (A, B, D, and J) are ranked higher. Ranking of impacts of each plan is based on available raw data. In the absence of specific data, the best collective judgment of the Agency Management Group as to relative impacts is presented. Cost data were preliminary.

B.2.81. The 70-percent Lower Atchafalaya River/30-percent Wax Lake Outlet flow distribution at the outlets, with sediment redistribution, would allow for rapid release of floodwaters from the basin, with an opportunity to maximize the natural resource values of the developing delta.

B.2.82. Plan B. This plan would prevent future clearing or timber operations in the floodway, resulting in a loss of income; however, it would provide for public access. While it would preserve existing open water areas, land would become inundated less frequently. This plan is moderately good for water-related environmental values and excellent for land-related environmental values.

B.2.83. Flood protection for the area east of Morgan City would be the same as for Plan A.

B.2.84. Plan C. This plan would significantly increase Mississippi flows below Old River and adversely affect Mississippi River navigation. Decreased water levels in the Red River backwater area and the basin would significantly decrease environmental values but would increase agricultural production potential appreciably.

B.2.85. Lack of any land use controls within the floodway, coupled with the decreased water levels in the basin, would result in substantial land clearing during the life of the project, with the attendent loss of environmental resources, especially fish and crawfish.

B.2.86. The area east of the floodway would continue to receive backwater flood protection to current levels which would result in the opportunity for additional economic development.

B.2.87. Plan D. This plan would provide for the presently authorized distribution of flows between the Mississippi and Atchafalaya Rivers and would not change water levels in the Red River backwater area. As a result of fee acquisition, the basin's environmental values would be preserved; public use of the area would be provided; and commercial crawfishing, fishing, trapping, general recreation, and sport hunting and fishing would be greatly benefited.

B.2.88. This plan is second only to Plan A in preserving the basin's environmental values, and it is also as good as Plan A in providing for public access. It would prevent additional agricultural development within the Atchafalaya Basin Floodway, which would result in loss of income.

B.2.89. The effect on the area east of Morgan City, flow distribution through the outlets, and delta building would be the same as discussed in Plan A.

B.2.90. Plan E. The increased flows down the Mississippi River would adversely affect Mississippi River navigation, but not as much as Plans A or C. The reduced stages in the Red River backwater area would reduce environmental values and increase agricultural production.

B.2.91. Within the floodway, clearing would be prevented, and associated agricultural benefits foregone. Although sediment control features would preserve open water areas, land would be flooded much less frequently. This plan has the lowest water-related environmental values except for Plan C. Land-related environmental values would be good, with only Plan B being better. The lack of public access would limit general recreation and hunting values. The drier overbank conditions would be excellent for commercial timber.

B.2.92. The Avoca Island levee extension feature would give the area east of the floodway continued protection and allow continued growth.

B.2.93. Plan F. This is similar to Plan D, except that an easement in lieu of fee acquisition would be provided and the Avoca Island levee extensions constructed. Public access would be regulated and no area (for example, ridge areas with permanent camps or residences) would be excluded from the easement area. The area east of Morgan City would be provided protection from backwater flooding, allowing continued growth.

B.2.94. Generally, this plan provides for a moderate increase in delta development.

B.2.95. Plan G. The sediment control features would preserve open water areas and, to some extent, the overflow regime in the lower parts of the basin. It does not provide for land use controls; hence, future clearing for agriculture can be expected. This plan ranks high for agriculture and low for land-related environmental values.

B.2.96. The limited structural measures for the area east of the floodway would cause relocations and limit growth.

B.2.97. Plan H. This is the authorized plan. Dredging the 100,000-sf channel would reduce sedimentation in the backswamp areas, but would accelerate draining these areas. Because the plan includes no land use controls, agricultural development in the floodway would continue at the expense of environmental values.

B.2.98. The Avoca Island levee extensions feature would provide continued backwater protection for the area east of the floodway and allow future growth.

B.2.99. Plan I. With this plan, floodway guide levees and floodwalls would continue to be raised. Within the floodway, its impacts are

much the same as those of Plan H. The combined flood-carrying capacity of the outlets would continue to decrease, resulting in increased backwater flooding. Since no protective measures for the area east of the floodway would be provided, flood damages in that area would be severe.

B.2.100. Plan J. This is identical to Plan F, except for the type easement acquired. Government control of timber would provide an opportunity to maintain mature, mast-bearing trees for wildlife as well as trees for cavity-nesting animals.

Features Eliminated from Further Consideration

B.2.101. Utilizing the relative economic and environmental analyses of plan features, the analysis of the plans formulated by the Agency Management Group for the 1979 public meetings, and the results of the meetings themselves, those features to be eliminated from further study could be delineated.

B.2.102. Group I - Alternatives for Operation of the Old River Control Structure. The 1978 analyses indicated that the 35-, 40-, and 45-foot plans would result in greater agricultural development within the Lower Atchafalaya Basin Floodway and the Red River backwater area; however, they would also cause extensive fish and wildlife losses. The clearing that would result from the 35-foot plan with no land use controls could destroy up to 500,000 acres of the 3 million remaining acres of bottomland hardwoods in the southeastern United States. Since little support was received at the January 1979 public meetings for any of these plans and due to agreements among Agency Management Group members, the plans were eliminated from further consideration. It was determined that in some years, flows into the Red River backwater area could be limited during May, June, and July without causing serious damages to environmental interests in the floodway. Conversely, it was also determined that during other years, slightly more water could be passed down the Atchafalaya River without harming agricultural interests. Since short term changes in flow distribution could possibly be accomplished without adversely affecting other resource uses, that variation of this plan was not eliminated from further consideration.

B.2.103. Subsequent to the public meetings, an analysis of the Mississippi-Atchafalaya River system for a 60/40 distribution was performed. The results of this work are discussed in the following paragraphs.

B.2.104. The rating curve for the Mississippi River at Tarbert Landing showed a loss of channel capacity during the period 1950-75. For a discharge of 1,100,000 cfs, the stage in 1950 was 49.5 feet NGVD; in 1973 it was 53.0 feet NGVD; and in 1975 it was 55.0 feet NGVD. During the greater part of this time period, distribution of flows was not controlled daily, and in 1974 the Mississippi River carried as little as 56 percent of the daily latitude flow. In 1976, rehabilitation of the Old River control low sill structure, necessitated by 1973 flood-induced damages, had progressed to the point that effective control of latitude flow to the 70/30 distribution was again possible. Under such control, the rating curve at Tarbert Landing in 1977 and 1978 reflected a steady increase in channel capacity, so that the rising limb of the 1979 rating curve in the early phases of the 1979 rise was nearly the same as the rising limb of the 1950 rating curve, which was about as low as had been observed in the entire period of record.

B.2.105. Subsequent events, however, reflect changes in the capacity of the Mississippi River. In the early part of May 1979, large amounts of deposition were observed at Tarbert Landing. It is reasonable to conclude that significant deposition also occurred throughout the Morganza-Tarbert Landing reach, inasmuch as the stage-discharge relationship at Tarbert Landing tended dramatically to the left, and by the 1979 flood's crest on 23 April, the indicated stage-discharge relationship at Tarbert Landing was about the same as a direct extrapolation of the 1975 relationship. Subsequent measurements as the river fell reflected that the 1979 and 1975 falling limbs were about the same. It is likely that if the 1979 flood had occurred with the 1975 rating curve, peak stages at Old River control would have been substantially higher than those that actually occurred. The actual peak stage in 1979 was about three-quarters of a foot higher than that of 1973, the highest stage experienced since 1927.

B.2.106. The events of the 1979 flood do not, in themselves, constitute an unassailable case for maintaining a 70/30 distribution of latitude flow; but when combined with the behavior of the Tarbert Landing rating curves in 1976, 1977, and 1978, these events do indicate clearly that any change in distribution toward placing a greater flow into the Atchafalaya would be very questionable.

B.2.107. A plan to maintain 60/40 distribution is not a plan for long term management of floods on the lower Mississippi. Instead, it would be a step toward inducing capture of the Mississippi by the Atchafalaya, which, in turn, would result in massive socioeconomic disruptions. If the 60/40 distribution were instituted and instability ensued, the only possibility for avoiding capture would be the return to a 70/30 distribution, keeping more flow in the Mississippi, and even this could not guarantee the desired result.

B.2.108. In summary, maintaining a 70/30 distribution provides a high degree of assurance that the project flood could be safely passed to the gulf. Conversely, a 60/40 distribution provides assurance only if it produces a stable configuration, a condition contrary to what is indicated by data and studies performed to date. The inadequacies of a plan incorporating a 60/40 distribution could not be rectified by constructing a new Old River control structure, however substantial it might be.

B.2.109. Data available to date clearly confirm that little advantage is likely to occur from increasing latitude flows to the Atchafalaya. In fact, this information suggests that the consequences are likely to be adverse or even cataclysmic. Thus, both 60/40 and 65/35 distribution features were eliminated from further consideration.

B.2.110. Group II - Atchafalaya Basin Main Channel Development Alternatives. Engineering and environmental studies performed during evaluation of preliminary plans indicated that dredging a confined 100,000-sf main channel would adversely impact more than 20,000 acres of woodlands and wetlands. Other main channel development alternatives would also result in adverse impacts; therefore, this feature was eliminated from further consideration.

B.2.111. Because an EPA study indicated that an 80,000-sf channel would be the largest to develop naturally, this feature was carefully analyzed. Subsequent studies by the Corps of Engineers have shown that the main channel, over time, would enlarge itself naturally to approximately 100,000 sf. Nevertheless, first costs and average annual equivalents were computed for the 80,000-sf channel. Both far exceeded the cost of other Group II features being investigated. As a result, no further consideration was given to this alternative.

B.2.112. Group III - Alternatives for Sediment Control. Sedimentation in the Lower Atchafalaya Basin Floodway is largely carried into the floodway via distributaries of the Atchafalaya Basin main channel. The sediment transported by a distributary can be divided into two components: bedload and suspended load. The bedload consists of coarse particles or sand; the suspended load generally consists of fine particles of mostly silt and clay. There is no reasonable means to reduce the suspended load short of flocculation, which is extremely expensive and, therefore, infeasible for use on the scale which would be required. Bedload, on the other hand, can be reduced in the distributaries by two techniques: distributary channel realinement and sediment traps. These two features can act either independently or together to provide sediment control. The effectiveness of each feature, whether used separately or in conjunction, is difficult to determine using state of the art literature. Also, direct measurement of bedload in the Atchafalaya River is not practicable. Based on Einstein's approach, as modified by Toffaleti, the bedload in the Atchafalaya Basin main channel is estimated to comprise 15 percent of

the total sediment load. The percent of bedload leaving the main channel is, for all practical purposes, indeterminate. However, bedload sediments usually deposit in three areas: those remaining in the main channel deposit at the lower end of the channel (Atchafalaya Bay); those entering and remaining within a distributary channel deposit at the lower end of the distributary channel; and those leaving either the main or distributary channels as overbank flow deposit adjacent to those channels in the form of alluvial levees. If backswamps are defined as areas not included in the preceding three areas, then only a negligible amount of sediment entering the backswamp is from bedload. By this definition, areas such as Grand Lake, Sixmile Lake, and Lake Chicot are not considered backswamps. Data are not available to determine the percent of deposits in the backswamps; however, it is likely that sands attributed to normal overbank flows constitute a small portion of backswamp deposits.

B.2.113. For the basin as configured in 1975, it is estimated that 20 percent of the sediment is transported into the overbank areas of the Atchafalaya Basin during floodflows (450,000 cfs and above). With time, because of overbank deposition and channel development, sediment in the overbanks made by floodflows will increase to 40 percent. While the percent deposited due to floodflows cannot be determined directly, it may be assumed that the percent deposited during floods is in proportion to the percent being transported.

B.2.114. Sediment traps were eliminated from further consideration due to their requirements for large amounts of land to be used as dredged material disposal areas and the environmental impacts of that disposal. Annual dredging of these traps would require disposal on approximately 3,000 acres of forest and swamplands adjacent to the traps. As a result, little vegetation of commercial value or of value to wildlife would become established at disposal sites.

B.2.115. Group IV - Management Units and Related Features. Subsequent to the 1979 public meetings, management unit area designations were adjusted by Agency Management Group consultations to add Sixmile Lake, Lost Lake, and Cow Island, and to combine Crevasse with Upper Belle River, for a new total of 13 units. Although preliminary studies indicated that some units have a higher potential for restoring historic hydrologic conditions, no units were eliminated from further consideration in preliminary planning stages.

B.2.116. Group V - Alternative Land Use Plans. No land use plans were eliminated in preliminary planning efforts.

B.2.117. Group VI - Alternatives for Floodway Outlets and Delta Building. Engineering evaluation of the floodway outlets and delta building alternatives indicated that construction of levees only, a new floodway outlet near Charenton, a new overbank outlet east of the floodway, or redistribution of major flows to Wax Lake Outlet would

require significantly higher costs than other alternatives. Additionally, land and water requirements for redistribution of major flows to Wax Lake Outlet and a new overbank outlet east of the floodway would be significant. Thus, all of the preceding alternatives were eliminated.

B.2.118. It was determined that if the outlets continue to develop naturally, a 50/50 distribution would result with an overall decrease in the outlets' combined capacity. Since this would violate the planning constraint of safely passing the project flood to the gulf, this alternative was also eliminated.

B.2.119. Group VII - Alternatives to Reduce Backwater Flooding East of the Floodway. None of the plans formulated during early study efforts were eliminated from detailed consideration.

B.2.120. Group VIII - Management Entity. This alternative feature could not be evaluated until the final array of plans was selected.

Features Considered in Detail

B.2.121. A discussion of the features considered in detail is provided in the following paragraphs.

B.2.122. Group I - Alternatives for Operation at the Old River Control Structure. The only measure in this group to be considered in detail is one that will maintain the present 70/30-percent distribution of total flows between the Mississippi and Atchafalaya Rivers below Old River. This alternative includes the possible short term variations in flow previously described.

B.2.123. Group II - Alternatives for Atchafalaya River Main Channel Development and Levee Raising. Levee raising has been an ongoing process since the inception of the Mississippi River and Tributaries project and would be required as part of any plan. However, levee raising without any other measure for passing the project flood through the Lower Atchafalaya Basin Floodway is a viable alternative. It can reasonably be assumed that if no Federal action were taken to address the study planning objectives, the accompanying increasing threat of a severe flood affecting the urban and industrial areas south of Old River would cause local or state governmental entities to continue to raise the levees to preserve the flood-carrying capacity of the floodway. As a result, this feature remained in the planning process and constituted the basic element of the plan that represented future conditions with no further Federal actions (future without-project condition).

B.2.124. Evaluation of the channel training feature indicated that it would provide a net cost savings by reducing the height to which basin protection levees would have to be constructed, while also limiting environmental losses to a greater degree than other alternatives considered. Because of this, channel training was an integral feature of the final array of plans considered.

B.2.125. A similar alternative feature not previously considered was introduced subsequent to the public meetings. This feature provided for dredging portions of the main channel to a much lesser degree than had previously been considered. The modified dredging plan provided for removing about 32,800,000 cubic yards of material from the main channel between mile 101 and mile 114, and because of its potential for decreasing the project flood flowline, this alternative was incorporated in the final array of plans. Subsequent analysis, however, indicated that the differences between channel training and modified dredging were minor and would provide only insignificant differences in the flood flowline and levee height requirements and, therefore, would not effect a cost reduction.

B.2.126. The 100,000-sf dredging plan, presented in the 1963 general design memorandum as the "authorized" plan, provided for dredging from mile 54.5 to mile 111.9 in steps of 60,000 sf, 80,000 sf, and then 100,000 sf. The plan included continuous monitoring to determine if the next step of dredging was required. Of the 443,000,000 cubic yards of dredging expected in 1963, actual dredging of 158,000,000 cubic yards was completed through 1968. Since then, with natural erosive action of the river, enlargement has continued so that now it is estimated that only about 240,000,000 cubic yards would need to be dredged to complete the project as authorized. When compared to only approximately 29,000,000 cubic yards required for channel training, the potential environmental losses were readily apparent. For this reason, completion of the 100,000-sf dredging plan was considered only in the detailed evaluation of the "authorized" plan.

B.2.127. Group III - Alternatives for Sediment Control. As discussed previously, sediment control can be effected by two measures: channel realinement and sediment traps. Because of projected environmental losses and probable ineffectiveness in preventing sedimentation in backswamp areas, sediment traps were eliminated from further consideration. Ongoing model studies at the Waterways Experiment Station (WES) are expected to determine the effectiveness of distributary realinements. The results of these studies will be incorporated into subsequent detailed studies prior to proposed implementation of distributary realinements.

B.2.128. Group IV - Management Units and Related Features. Analysis of the management unit concept indicated that initial implementation of all 13 management units would not be appropriate. Two units, Buffalo Cove and Henderson, should be considered for initial

implementation as pilot projects. Then, based on detailed studies of operation of the two units with representatives of the USFWS, EPA, and appropriate state agencies, recommendations would be made on the engineering and environmental feasibility of developing other management units. Development of other units should be considered.

B.2.129. For the proposed Buffalo Cove pilot unit, a typical design might include control of water into the main portion of the unit by construction of an inlet structure at the junction of the Wanda Canal and the west access channel. Banks around the southwest perimeter of the area would be raised only as necessary to confine average annual peak flows. Two weirs would control outflow from the area. One weir could be located at the main channel leading out of Buffalo Cove Lake and the other about 1 mile south of the Iberia-St. Mary Parish line in Grand Lake. Closures and boat rollover structures would be built at Bayou Eugene where it enters the west access channel and at Si Bon Canal where it enters Lake Fausse Point Cut. An additional boat rollover structure would be built to provide access from Lake Fausse Point Cut into Bayou Gravenburg. To improve water circulation in the unit, openings in canal dredged material banks could be made along the Si Bon Canal, the Wanda Canal, and the Florida Gas Canal.

B.2.130. In the western portion of this unit, inflow of water could be via Little Lake Long with outflow regulated by a weir in the vicinity of Myette Point. Banks along the southeast perimeter of the area would be raised as needed to confine the average annual peak flows.

B.2.131. Inflow of water into the Henderson Lake area could be controlled by the existing Bayou Courtableau structure and the Courtableau water diversion structure, which would be built to divert up to 3,000 cfs from the Atchafalaya River into Bayou Courtableau. Outflow would be via the existing control structure in the borrow pit southwest of Butte LaRose.

B.2.132. Also proposed, as a part of the management unit feature, was construction of the Courtableau and Sherburne freshwater diversion structures. As noted, the Courtableau structure at river mile 48 would serve as an inlet for the Henderson Lake management unit. The Sherburne structure, a gated culvert at river mile 43, would provide freshwater to the Alabama Bayou area by passing up to 3,000 cfs into Big Alabama Bayou. Canal closures and circulation improvements, also part of the management unit concept, would be included in detailed plans.

B.2.133. Closure of certain canals would prohibit sediment-laden waters from entering backswamp areas; selective opening of existing dredged material banks and other features that impede circulation would improve water circulation.

B.2.134. Group V - Alternatives for Floodway Land Use. All real estate interests previously considered were made up of a number of interests which varied from plan to plan. Typical easement and fee title estates included the following:

- Control over conversion of land to other uses
- Prohibit new structures for permanent human habitation
- Prohibit or control other structures, including camps
- Control over excavations and landfills
- Government ownership of timber
- Control over the method of cutting timber
- Permit public access
- Prohibit camps
- The right to flood by any means, for any purpose, and for any length of time
- Occasional flowage rights
- Fee ownership less minerals.

B.2.135. These estates were evaluated separately and in various combinations. The real estate feature was considered additive; i.e., it could be added to any of the final array of plans without affecting the project flood flowline.

B.2.136. During the final phases of this study, the Corps of Engineers solicited real estate recommendations from all Agency Management Group members. Real estate proposals were submitted by USFWS, EPA, and the State of Louisiana for consideration. Because the people residing in the state would be the primary beneficiaries of additional public access in the basin, it was determined that proposals for public access should be in accordance with the State's recommendations.

B.2.137. Group VI - Alternatives for Floodway Outlets and Delta Building. In analyzing the plans for passing the project flood through the outlets to the Gulf of Mexico, it became apparent that these alternatives would have significant effects on the total cost of completing the Atchafalaya Basin Floodway project. Without any control at the outlets, their combined capacity would decrease and the corresponding flow distribution would become approximately 50 percent out Wax Lake Outlet and 50 percent out the Lower Atchafalaya River.

B.2.138. Stabilization of the existing flow distribution, with 30 percent from Wax Lake Outlet, can be achieved by construction of a rock weir at the head of Grand Lake. Calculations indicate that because of high velocities, a gated control structure could be required to control the distribution so that 20 percent of the flow would pass out Wax Lake Outlet. Closure of Wax Lake Outlet to normal flows would also require a rock weir.

B.2.139. Each of these alternative features is incorporated into the final array of plans. While total one-shot restrictions to 20 percent or 0 percent out Wax Lake Outlet would offer the advantages of an anticipated enlargement of the Lower Atchafalaya River cross section, a greater combined outlet capacity, and a future lowering of flowlines in the area, an immediate implementation of such a closure would, in the short term, result in an increase in stages (for low and medium flows) in the vicinity of Morgan City and east of the Avoca Island levee. With the current level of protection and flooding problems in these areas (which occur even for the stages associated with a low-level closure), any increase of stages would be unacceptable. Therefore, maintenance of the 70/30 percent distribution through the Lower Atchafalaya River/Wax Lake Outlet is preferable from an engineering standpoint. However, as noted previously, the rock weir would result in some reduction in low flow and some enlargement of the Lower Atchafalaya River would occur. The effectiveness of the weir could be monitored and if the Lower Atchafalaya River and ecosystem of the area responds favorably, the possibility of further constricting flow through Wax Lake Outlet and eventually constructing a low-level closure could be studied further.

B.2.140. Based on this, some plans in the final array were developed with an initial 70/30 distribution, with possible restrictions to a 80/20 distribution and eventually to a 100/0 distribution. Since it could not be determined if additional restrictions would be desirable in the future, a cost estimate for further restrictions was not developed. Calling the alternative a 70/30 distribution with further restrictions to 80/20 and 100/0 distributions is merely a way of describing these alternative features.

B.2.141. Channel training works below Morgan City would effect a reduction in the project flood flowline and be additive to any of the flow distributions previously discussed. As a result, this measure was included as a separable feature in the final array of plans.

B.2.142. Flowline comparisons made prior to the 1979 public meetings indicated that channel training on both the Lower Atchafalaya River and Wax Lake Outlet was cost effective, resulting in savings varying from $18 million to $87 million. Training works would be provided in phased steps, depending upon natural deltaic activity. The cost estimates reflect cost of the training works, which would extend only to the existing mouths of the outlets. Since it is not known to what

extent any future training works might be required, no cost estimates were developed for the future works. The flowlines, however, reflect possible continuance of the channel training program as the mouth of the Atchafalaya River moves gulfward with time because of continued delta development.

B.2.143. The project flowlines for the final array of plans represent conditions 50 years in the future. Such projections must be based on subjective evaluations of future development. All studies of the Atchafalaya River to date have concluded that the bay will continue to develop and, therefore, the mouth of the river will continue to move farther into the bay. As this occurs, it is assumed that what can be done above the mouth to help improve flow in the river now, would also be applicable above the mouth of the river in the future. Current evaluation of channel training works on the outlets indicates that while the training works will reduce overbank deposition, the area would still have a net gain in overbank area. The Atchafalaya Bay modeling effort currently being conducted by WES is expected develop a tool to determine how the proposed channel training works will affect future delta building, salinities, and overbank sediment.

B.2.144. Widening Wax Lake Outlet overbank would allow use of the overbank area during floods exceeding the 10-year frequency. The additional overbank area results in a considerable increase in conveyance capacity of the outlets during a project flood in which the flow distribution would change to about 55/45 percent Lower Atchafalaya River/Wax Lake Outlet. Comparisons of a plan, both with and without the widened overbank, indicate that the project flood elevation can be reduced as much as 3 feet with the widened overbank.

B.2.145. Although no increase in delta would result from implementation of the above features, an increase in that portion of delta served by Wax Lake Outlet could be effected by increasing its share of sediment. This alternative was considered as a separable feature in formulating the final array of plans.

B.2.146. Group VII - Alternatives to Reduce Backwater Flooding East of the Floodway. The existing Avoca Island levee was built to limit project design flood stages east of Morgan City to stages that occurred in that area during the 1945 flood. However, since construction of the levee and the Bayou Boeuf closure would change the Morgan City-Amelia area from an area affected by headwater flow to one affected by backwater flow, the levee could not exactly duplicate conditions of the 1945 flood. The 1945 Atchafalaya River flood stage at Morgan City was 6 feet NGVD and about 4 feet NGVD between Morgan City and Gibson, Louisiana, and also between Morgan City and Pierre Pass, Louisiana. For the project design flood discharge without the Avoca Island levee, the peak stage east of Morgan City was, in the late 1940's, computed at 4 feet NGVD. To achieve the required project flood stage of 4 feet NGVD east of Morgan City, the new levee south of

Morgan City was alined parallel to the Atchafalaya River, extending about 13 miles south of the city, and terminating at a flowline elevation then estimated at 7.5 feet. The degree of protection provided by the levee varied with the location and elevation within the protected area. For all lands above elevation 4 feet NGVD, complete protection against a project flood was achieved. Lands below 4 feet NGVD, while overflowed, would be inundated to lesser depths and for shorter durations. The flood stage reductions would diminish with distance eastward from Morgan City toward Bayou Lafourche and northward toward Bayou Sorrel lock. Since the original design, deltaic activity below Morgan City has caused the stage at the end of the Avoca Island levee to rise by about 2 feet. To preserve the improvement intended under the original design, extension of the levee by about 2.5 miles is now required to compensate for this rise. As deltaic activity continues, additional extensions would be required to compensate for anticipated future increases in stages. If no extensions are constructed, stages at the end of the existing levee would ultimately rise by more than 6 feet, compared with stage conditions in 1945.

B.2.147. In addition to a proposed earthen levee extension of about 17 miles that follows the navigation channel, a number of alternatives were further investigated subsequent to the 1979 public meetings, including: levee extension with an I-wall; levee extensions utilizing marsh and bayshore alinements; a levee from Morgan City to Houma with pumping facilities for interior drainage; an urban/industrial complex ring levee and navigation structure system; a comprehensive ring levee/pumping system to protect 28 selected residential and industrial developments; collapsible floodwalls around Morgan City and Amelia; and flood-proofing structures and relocating businesses and residences in conjunction with any of the above.

B.2.148. Although first costs were estimated to be close, further analysis of the 28-ring levee plan indicated a substantial annual cost differential above the cost of extending the Avoca Island levee. Additionally, ring levees would provide only localized protection as compared to the regional protection afforded by extending Avoca Island levee. Construction rights-of-way for the rings would necessitate relocation of some 1,900 existing residential, commercial, and public structures. Economically and environmentally, construction of a levee extension topped by an I-wall offered no advantages; moreover, the costs were higher. An analysis of the collapsible floodwall revealed that raising the wall and caulking the panels required 4 to 5 days with 10 days to 2 weeks' notice. The analysis also showed that the collapsible floodwall could not withstand heavy industrial traffic when in the stowed position. Flood-proofing structures in the entire backwater area is considered an impracticable and socially unacceptable solution, as is the relocation of businesses and residences outside the area. Further investigation of the marsh alinement for extending the Avoca Island levee also proved this to be undesirable from an environmental standpoint. Thus, two alternative features were

considered in the final array of plans: extension of the Avoca Island levee, using either the navigation channel alinement or the bayshore alinement, the first two reaches of these alinements follow the same route. Initially, a total extension of about 17 miles was considered. The location of each reach was determined from projections of the delta development in the bay, and an effort was made to keep the end of each levee reach at a point where the river stage would be 7.5 feet for project design conditions. Current estimates indicate that a total of six extensions would be required at approximately 10-year intervals. Exact requirements for future extensions would depend on the rate of development of the bay. Since extending the Avoca Island levee would reduce the amount of overbank area available for conveying a project flood, this could cause higher project flood stages on the Lower Atchafalaya River and thus, at the lower end of the East Atchafalaya Basin Protection Levee and West Atchafalaya Basin Protection Levee. The alinement of the levee immediately adjacent to the channel has the most significant effect by increasing flood heights over those without the extension by up to 2 feet. The bayshore alinement would increase available overbank area and thereby reduce flood heights. However, it should be pointed out that project flood flowlines for a plan that contains the channel alinement Avoca Island levee extension, control of the outlets flow distribution to 70/30, and widening the Wax Lake Outlet overbank is about 1.0 foot lower than the refined 1973 flowline in the Morgan City area and at the lower ends of both the East Atchafalaya Basin Protection Levee and West Atchafalaya Basin Protection Levee.

B.2.149. Because the marsh east of an Avoca Island levee extension depends upon the freshwater and sediment from the Lower Atchafalaya River for nourishment to prevent saltwater intrusion and marsh subsidence, a freshwater diversion structure or structures, was included as part of the extension alternative. The structure was designed to maintain the present distribution of nonfloodflow, currently estimated to be 4,000 cfs, into the west Terrebonne Parish marsh. The structure would divert water into the area until the stage at Amelia, Louisiana, reached 3.0 feet. At this point the structure would be closed for flood protection. The stage duration curves indicated that this stage would occur less than 1 percent of the time with the levee extension. Since freshwater diversion would, on the average, be available 99 percent of the time, no change is expected in the salinity regime due to the project. Sediment concentration of the diverted water would be the same as current diversion concentrations, but it would be more localized. Therefore, increases in marsh loss could be caused by the extension.

B.2.150. Extension of the Avoca Island levee would also require navigation access at the end of each reach or through the levee itself. A navigation structure through the levee would be included in the bayshore alinement. During low to normal floodflows, this would also provide additional diversion of freshwater and sediment to the eastern marshes.

B.2.151. A preliminary environmental analysis indicated that construction of a 14,000-foot extension would not foreclose future options with respect to the Lower Atchafalaya River complex. This analysis, combined with the fact that the levee extension is the only alternative which would protect the entire backwater area, and the largely unknown environmental impacts of the total extension led to the decision to construct only 14,000 feet of the levee extension initially. Protection provided, however, is only a temporary solution. This interim protection would provide an opportunity to complete model tests of the bay complex, review the results, and conduct additional engineering and environmental studies of the backwater area. In order to have a comparable base over the project life, the flowlines used in the economic and environmental analysis of the final array of plans included construction of the entire levee extension.

B.2.152. Group VIII - Management Entity. Since the management entity depends on the features contained in the final detailed plans being considered, a discussion of the management entity proposed for each of the final plans is included in the implementation responsibilities.

B.2.153. Recreation Features. A concept of potential resource use and allocation was developed, which would minimize overall land acquisition and development yet increase public access within the Lower Atchafalaya Basin Floodway. Included in this conceptual plan were areas having the potential to be used for or classified as wildlife refuges, natural areas, public hunting areas, public fishing and crawfishing areas, nature hiking, canoe trail areas, developed and primitive camping areas, boat-launching areas, and areas having significant and unique resources. A detailed discussion of recreation resources is presented in Appendix F.

Formulation of NED, EQ, and TS Plans

B.2.154. In order to prepare the draft feasibility study/EIS, it was necessary to formulate NED, EQ, and Tentatively Selected (TS) Plans for presentation to the public. A total of 10 plans was formulated, utilizing features previously discussed in conjunction with the planning goals and objectives, so that each could be evaluated as a complete unit in terms of its effects on NED, regional development, social well-being, and EQ objectives. These plans are shown in Table B-2-3. The table shows that Plan 1 describes existing conditions. Plan 2 reflects future without-project conditions. Plan 3 represents the 1963 authorized project. The other plans were formulated to represent EQ (Plan 4), NED (Plans 5, 6, and 7), and combinations of EQ

TABLE B-2-3

ALTERNATIVE STRUCTURAL PLANS

Feature	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7 a / b	Plan 8 a / b	Plan 9 a / b	Plan 10 a / b
Old River Control Structure 70%/30% Mississippi/Atchafalaya	---	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Levee Raising	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Main Channel:										
100,000 Square Feet Dredging (modified)	---	---	---	---	Yes	Yes	---	---	---	---
100,000 Square Feet Dredging	---	---	Yes	---	---	---	---	---	---	---
Channel Training	---	---	---	Yes	---	---	Yes	Yes	Yes	Yes
Sediment Control	---	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes
Management Units	---	---	---	Yes	---	---	No/Yes	No/Yes	No/Yes	No/Yes
Outlets:										
Lower Atchafalaya River/Wax Lake Outlet										
70% / 30%	---	---	---	Yes	---	---	---	---	---	---
100% / 0%	---	---	---	---	Yes	Yes	---	---	---	---
70% / 30% → 80% / 20%	---	---	---	---	---	---	---	---	Yes	Yes
70% / 30% → 80% / 20% → 100% / 0%	---	---	---	---	---	---	Yes	Yes	---	---
80% / 20%	---	---	Yes	---	---	---	---	---	---	---
Increase Sediment to Wax Lake Outlet	---	---	---	Yes	---	---	---	---	---	---
Widen Wax Lake Outlet Overbank	---	---	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Channel Training Below Morgan City	---	---	---	---	Yes	Yes	Yes	Yes	Yes	Yes
Backwater Flooding:										
Extend Avoca Island Levee	---	---	Yes	Yes	Yes	Yes	Yes	---	Yes	---
Limited Structural Measures	---	---	---	---	---	---	---	Yes	---	Yes

Note: To develop complete multi-purpose plans, a real estate option and a management entity alternative should be added to each structural plan. All plans include bank stabilization on the Atchafalaya River above mile 55, recreational developments and minor project features.

and NED (Plans 8, 9, and 10). Candidate NED plans were selected on the basis of their capability of generating the lowest possible flowline in the Lower Atchafalaya Basin Floodway, since conversions for agricultural purposes were considered as offering maximum economic return potential.

B.2.155. Features of the EQ plan were chosen to preserve environmental quality in the project area. The sediment control and management unit features would preserve aquatic habitat in the floodway. The extension of the Avoca Island levee was selected for the EQ plan because it was the only alternative considered in detail that reduced flood damages over the entire backwater area. The real estate interests proposed for the EQ plan preserved a large amount of habitat and allowed extensive public access.

B.2.156. Plan 6 was determined to be inferior to Plans 5 and 7 and was eliminated from further consideration as an NED plan because it did not include sediment control features. Sediment control is desired for the NED plan because it would reduce deposition of sediment in backswamp areas and tend to preserve the flood-carrying capacity of the basin. This would result in a lower flowline and a corresponding reduction in the required height and cost of the East and West Atchafalaya Basin Protection Levees.

B.2.157. The selection between the remaining possible NED plans was made on the basis of two features, main channel development alternatives and floodway outlet alternatives. Plan 5 incorporated modified dredging, which would provide essentially the same flowline as the channel training alternative of Plan 7, but would require larger quantities of material to be dredged, generate higher costs, and produce slightly more environmental damage. The elimination of Plan 5 was also supported by the fact that the flow between the Lower Atchafalaya River and Wax Lake Outlet would immediately redistribute from the existing 70 percent via the Lower Atchafalaya River and 30 percent via Wax Lake Outlet to 100 percent and 0 percent, respectively. This shift in flow would result in additional flood damages in the backwater area east of the floodway because of the greater flow down the Lower Atchafalaya River. Flow distribution in Plan 7 would shift gradually from 70/30 to 80/20 and then to 100/0.

B.2.158. The ultimate shift from 70/30 to 100/0 is desirable because it would allow time for the Lower Atchafalaya River to more fully develop, thereby increasing the total outlet capacity of the basin. The more gradual shift from 70/30 to 100/0 with Plan 7 is desirable because by allowing the Lower Atchafalaya River to more fully develop while increasing its flows, there would be little or no additional induced damages in the backwater area northeast of Morgan City resulting from the changes in flow distribution. Thus, Plan 7 was selected as the NED plan.

B.2.159. One of the major considerations in the selection of the TS plan was the Avoca Island levee extension. Plan 9 includes extension of the Avoca Island levee, while both Plans 8 and 10 contain the ring levee limited structural features. Plans 8 and 10 were not chosen because of cost and the social impacts of such features and because they would not fully address the need to reduce backwater flooding throughout the backwater area. The total first cost of the bayshore levee extension would be $338,800,000, while costs of 28 small ring levees would be $377,100,000 and the cost of two large ring levees with navigation structures would be $365,000,000. (Costs shown are October 1980 price levels.) While the total cost of the bayshore levee extension and the 28 small ring levees would be approximately equal, there would be a significant difference in actual annual costs. The annual costs, including operations and maintenance, for the bayshore levee extension and the 28 small rings would be $14,965,000 and $27,204,000, respectively. Since extending the Avoca Island levee would result in higher project flood stages in the lower end of the floodway, a first cost of $30,000,000 was incorporated into the calculation of the bayshore extension annual costs to account for additional construction requirements as well as a first cost of $10,000,000 for a water diversion structure recommended by the FWS. Annual costs for the bayshore extension were substantially lower than the 28 ring levees for two reasons. First, the bayshore extension would involve phased construction, which would occur over a period of about 40 years, thereby reducing the present value of construction costs on which the annual costs are computed. Second, the 28 rings would have an annual operation and maintenance charge of about $3,500,000 compared to a negligible charge for the bayshore extension. If the Avoca Island levee extension were not built, the flowline of the backwater area would continue to rise over the next 50 years. Headwater runoff and tidal influences account for about 50 percent of the existing flooding in the area, with backwater accounting for the remainder. This distribution of floodwater effects will change significantly by the year 2030 as the flooding from backwater influence intensifies. Based on existing development only, the average annual damages for 1980 are estimated to show more than a 20-fold increase by 2030. This dramatic increase would be due entirely to backwater stages rising because of the continuing delta development and its accompanying river elongation. Thus, the need for regional protection of the area from backwater influences will continue to become more acute. While the 28-ring levee plan would provide complete protection from headwater, tidal, and backwater influence with the selected leveed areas, this plan would leave the majority of the area unprotected in the face of ever-worsening backwater conditions, resulting in substantial residual backwater damages in the future. The construction rights-of-way for the ring levees would require the relocation of about 1,900 existing residential, commercial, and public structures. Evacuation and transportation routes would remain subject to flooding. Furthermore, all structures located outside of the ring levees would require

raising, flood-proofing, or removal for prevention of flood damages. Also, without the levee extension, rising waters in the backwater area could damage approximately 7,000 acres of prime and unique farmlands. It is anticipated that numerous archeological sites would also be adversely impacted by flooding. The ring levees would hasten the demise of the Cajun culture by removing the people from immediate access to the bayous. Therefore, Plan 9 was chosen as the TS plan because it was best in satisfying both the national economic development and environmental quality planning objectives.

B.2.160. Detailed studies were made of Plan 4, which emphasizes environmental quality; Plan 7, which emphasizes economic development; and Plan 9, which offered a balanced array of environmental and economic features.

Section 3 - ASSESSMENT, EVALUATION, AND COMPARISON OF NED, EQ, AND TS PLANS

B.3.1. This section assesses and evaluates the three plans prepared for the draft feasibility report/EIS. Costs and benefits presented in this section are those developed prior to publication of the report/EIS. This presentation lists each of the component features, portrays the pertinent aspects of the features which have not been described previously or which elaborate on specificity, evaluates the merits and drawbacks of proposed actions, and delineates the trade-off analyses performed for each of the three plans considered in detail. Plan impacts are discussed in the draft EIS and, therefore, are not included in this appendix. Responsibilities for implementation of the plans, including cost apportionment, are outlined for each plan. Mitigation requirements are also addressed.

Plan 4, Environmental Quality (EQ) Plan

PLAN DESCRIPTION

B.3.2. This plan is comprised of a combination of features that emphasize environmental quality and safely convey the project flood through the Atchafalaya Basin to the gulf. Its features are as follows.

B.3.3. 70/30-Percent Distribution of Flows at Old River. This is the present plan of operation for the Old River, Louisiana, project and has been described in detail previously in this appendix.

B.3.4. Modification of Existing Features, Where Required, to Pass the Project Flood. This feature includes raising the East and West Atchafalaya Basin Protection Levees, Atchafalaya River levees, and the levees west of Berwick to grade (Plate B-7), and constructing service roads on levee crowns; modifying Bayou Sorrel, Bayou Boeuf, and Berwick locks; modifying the Charenton, East Calumet, and West Calumet floodgates; modifying the Wax Lake East and Wax Lake West drainage structures; modifying culverts in the East and West Bayou Sale levees; and modifying the Upper Pointe Coupee, Centerville, Ellerslie,

Franklin and Enlargement, Gordy, Maryland, North Bend, Wax Lake East, Wax Lake West, Bayou Yokely and Enlargement, Morgan City, and Tiger Island pumping plants.

B.3.5. Bank Stabilization. Details of this feature are presented in this section under the NED plan.

B.3.6. Training Works on the Atchafalaya Basin Main Channel Above Morgan City. This feature provides for the construction of training works on the Atchafalaya Basin main channel to a height sufficient to confine average annual flows, approximately 450,000 cfs. This requires the dredging of approximately 29,000,000 cubic yards of material from 17.6 miles of channel, from mile 90.0 to mile 116.0, and placing it on the banks within diked disposal areas to simulate the development of natural ridges (Plate B-8). The majority of the works would be below mile 96.0 and would be completely confining; that is, no gaps would be left in the works to allow water to overflow the banks during low flows. Above mile 96.0, work would consist largely of closing gaps between existing disposal areas. Possible bank maintenance work may be required along the main channel in the future from mile 90.0 to mile 53.0 on the east bank and mile 55.0 on the west bank, but it is minor in nature and was not included in cost estimates or impact assessments.

B.3.7. Sediment Control. The sediment control component of this plan includes realining the four principal distributaries of the Atchafalaya Basin main channel to reduce the entrance angle to between 30 and 45 degrees. These distributaries are the Old Atchafalaya River, east freshwater distribution channel, the west access channel, and the east access channel (Plate B-9).

B.3.8. 70/30-Percent Distribution of Outlet Flows. This feature provides for maintaining the present distribution of flows at the outlets by constructing a rock weir at the head of Grand Lake with connecting levees to the West Atchafalaya Basin Protection Levee (Plate B-10). The weir is designed to allow 30 percent of the low to normal flows to reach the Gulf of Mexico through Wax Lake Outlet with the remaining 70 percent being conveyed to the gulf via the Lower Atchafalaya River. For flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that floodflows could be safely conveyed to the gulf via the Wax Lake Outlet.

B.3.9. Widening Wax Lake Outlet Overbank. The plan consists of setting back the west Wax Lake Outlet levee an average of approximately 3 miles to the location shown on Plate B-11. The existing west Wax Lake Outlet levee would be degraded to natural ground.

B.3.10. Extension of Avoca Island Levee. This feature consists of a 14,000-foot extension of the Avoca Island levee for the purpose of continuing backwater flooding protection in the area east of the lower

floodway. The length of time for which continuing protection is provided by this alternative is highly dependent upon the actual rate of development of the Atchafalaya delta. Based on current data, it is estimated that measures to provide additional protection from backwater flooding would not be needed until 1993. This extension would include a structure(s) to divert sufficient freshwater to maintain the present distribution of nonfloodflows, estimated to be 4,000 cfs, to the marshes in west Terrebonne Parish. The structure(s) would necessarily be closed when the stage at Amelia, Louisiana, reached 3 feet to provide an acceptable level of damage reduction from Lower Atchafalaya River backwater flooding.

B.3.11. This solution provides an interim period of protection which will allow completion of studies of the Atchafalaya Bay-Terrebonne marsh-backwater complex. Following more detailed studies, to include additional evaluation of the backwater problem and further investigations of the environmental, engineering and socioeconomic feasibility of alternative solutions, a decision would be made on the best means to address flood problems in the backwater area.

B.3.12. The flowline in the basin above Morgan City is affected by all flood control alternatives proposed for implementation in the area below Morgan City. In order to estimate comparable impacts and costs for the evaluation of all flood control features of the detailed plans on a common base, i.e., feature effects on the project flowline for the duration of project life, it was necessary to assume a long term solution to the backwater flooding problem. Since the full extension of Avoca Island levee is the only present long term alternative capable of reducing flood damages over the entire backwater area from both the EQ and NED standpoints, that feature was selected to provide the base for evaluating future project conditions. The EQ plan assumed extension of the levee for 19.6 miles along the bayshore alinement (see Plate B-6), with a navigation structure to provide navigation via the Avoca Island cutoff, to the Lower Atchafalaya River, and on to the gulf.

B.3.13. In summary, a 14,000-foot extension of the Avoca Island levee is proposed for implementation; however, costs and impacts of an entire levee extension were evaluated only as a means of comparing features of the detailed plans over the life of the project.

B.3.14. Recreational Development. This feature consists of three developed and seven primitive campgrounds, one interpretative facility, and 15 launching ramps (providing 51 total or 35 net additional launching lanes), located throughout the Atchafalaya Basin on 1,500 acres of acquired land [(owner retains mineral rights) (Plate B-12)].

B.3.15. Management Units. Thirteen management units (Figure B-3-1) were studied to determine their feasibility for restoring historical water overflow conditions to benefit the aquatic ecosystem. The

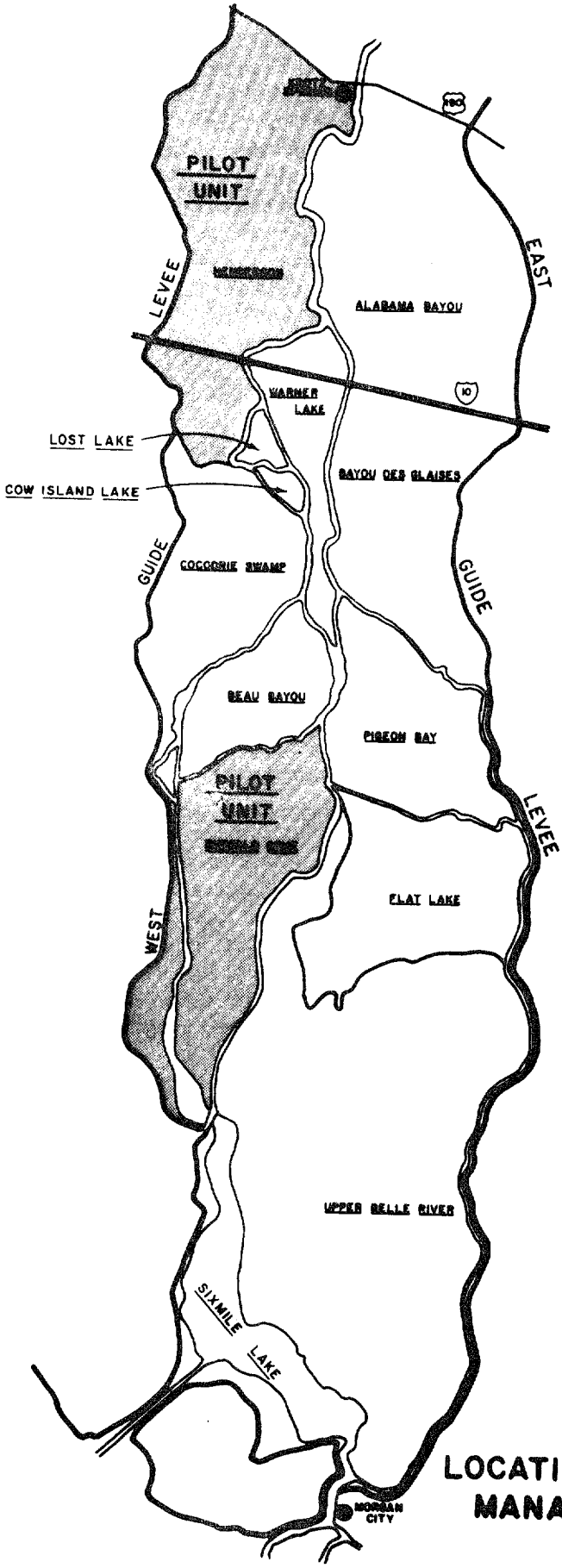

FIGURE B-3-1

LOCATION OF PROPOSED MANAGEMENT UNITS

studies to date indicate that five units--Buffalo Cove, Henderson Lake, Beau Bayou, Flat Lake, and Cocodrie Swamp--have the greatest potential for accomplishing that goal. For this reason, these five were specifically included in the plan evaluation and the costs, benefits, and impacts developed for detailed plan comparison purposes. The Buffalo Cove and Henderson Lake units are proposed as pilot units for initial implementation according to plans developed in conjunction with representatives of USFWS, EPA, and appropriate state agencies. Subsequent to construction, the operation of these units would be closely monitored and an evaluation of their performance made by representatives of the cooperating agencies, using criteria devised by that group, concerning the pilot units' effectiveness in enhancing the aquatic environment. Based on that group's evaluation and recommendations, requests for funding to implement other units would be made. Prior to that time, it is not possible to determine how many additional units are engineeringly and environmentally feasible for implementation. Development of management units would require the restriction of their natural outlets by construction of weirs and in some cases, low-level levees (see Plate B-13). Construction of new inlets at the upper end of the management unit would also be necessary, as well as the closure of certain bayous and canals and the improvement of circulation within the unit. Rollovers to provide for small boat access would be installed at bayou and canal closures.

B.3.16. Freshwater Structures. This feature provides for the construction of the Courtableau and Sherburne freshwater diversion structures to provide freshwater inflow to the Henderson Lake and Alabama Bayou areas, respectively. The Courtableau freshwater diversion structure would serve as an inlet for the Henderson Lake management unit area. It would consist of two 10-foot box culverts with invert elevations of 10 feet NGVD, located in the West Atchafalaya River levee at approximate mile 48.

B.3.17. The Sherburne freshwater diversion structure, which also includes two 10-foot box culverts with invert elevations of 10 feet NGVD, would be located in the east Atchafalaya River levee at mile 43.

B.3.18. Real Estate Interests. The real estate feature of this plan provides for those interests needed to serve three basic functions: flood control, environmental protection, and public access. Real estate interests for both flood control and environmental purposes were developed in specific response to study objectives cited by the authorizing congressional resolutions. The public access function is ancillary to the proposed environmental features of the project, with the citizens of the State of Louisiana being the primary beneficiaries. The state expressed the view that public access in addition to the current state-owned lands (approximately 150,000 acres) was desirable. For this reason, the public access interests proposed were developed in accordance with the recommendations of the Governor, and if authorized by the US Congress, would be acquired in coordination with the state.

B.3.19. The EQ plan provides a real estate feature which addresses both flood control and environmental protection purposes as follows:

• Flood Control. The Flood Control Act of 1936 authorized the US Army Corps of Engineers to acquire certain flowage rights in the Lower Atchafalaya Basin. The Act further specified; "That no flowage easements shall be paid for by the United States over properties subject to frequent overflow in the Atchafalaya Basin below the approximate latitude of Krotz Springs." It was determined that about 68,000 acres in the Lower Atchafalaya Basin Floodway were subject to purchase of flowage easements under this Act. To date, those easements have been obtained on about 9,000 acres. The EQ plan proposes the purchase of flowage rights on the remaining 59,000 acres. In addition, the right to prohibit the construction of new permanently habitable structures and to prohibit or regulate construction of other structures, including camps, would be acquired over all privately-owned land (approximately 445,000 acres) in the lower basin, except for developed ridges. The need for developmental control is associated with operation of the floodway. This right would assure the lower floodway's readiness for operation on short notice, preclude the need for Corps of Engineers emergency flood-fighting operations and associated Federal expenses within the basin, and insure no liability on the part of the Federal Government for the public health, safety and welfare by controlling industrial development that could prove hazardous to the public during floodway operations. These developmental control rights would also serve to preserve the environmental values of the basin, but are considered essential elements of a flood control easement which would provide for the continued unrestricted use of the lower floodway for project flood control purposes.

• Environmental Protection. Real estate interests proposed for protection of environmental values in the lower basin were developed in response to general study goals of the authorizing congressional resolutions and specific study objectives as defined by the Agency Management Group, i.e., to "retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands." In addition to those rights needed for flood control, the EQ plan proposes rights specifically for environmental protection. These rights are considered necessary for preservation of fish and wildlife habitat and maintaining the "wet and wild" environmental appeal of the lower floodway. Such rights would include control over all excavation and landfill operations and allow for extension of the time and duration of flooding by natural or artificial means. These rights would prevent or delay potential degradation of existing flowage patterns, prevent destruction of habitat and provide for water

level control under the proposed management unit concept. Additional environmental rights would prevent the conversion of land to other uses and provide control over the method of cutting timber. The proposed land conversion control is directed at preventing destruction of fish and wildlife habitat, i.e., clearing of forests for the purpose of agriculture, production of soybeans, or other higher value economic pursuits. Control over timber is also aimed at preserving habitat, as well as maintaining the lower basin's environmental appeal by controlling clearcutting forestry practices. A comprehensive multi-purpose easement, or higher interest if mutually agreed upon, containing the cited environmental interests would be acquired over the entire 445,000 acres of privately-owned land in the lower basin except for developed ridges.

• Public Access. The public access function was subdivided into two basic categories that relate to separate features of the proposed plan. The first, recreation development, was formulated in response to the study authorizing resolutions. The second, general public access, was developed in response to the Agency Management Group defined objective to "maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway" and is based on the recommendations of the Governor of the State of Louisiana.

For the recreational development feature, a total of 1,500 acres would be acquired in fee title throughout the lower floodway to provide for the development of campsites, boat-launching ramps, and other facilities complimentary to destination-type outdoor recreational activities. Included would be a limited number of day-use or picnicking sites and 200 to 500 acres set aside for special and unique areas.

The general public access feature would be accomplished by the acquisition of such additional rights on 103,500 acres of the same 445,000 acres previously cited for environmental protection easements. The public access areas would include 30,000 acres of late successional bottomland hardwood forests, 50,000 acres of cypress-tupelo swamps, 23,000 acres of greenbelts along the edges of selected navigable public waterways and sites along the interior toe of the basin protection levees, and 500 acres of existing rookeries. Additional rights to prohibit harvest of timber would be obtained on 73,500 of the same acres (30,000 acres of bottomland hardwoods, 20,000 acres of cypress-tupelo stands, 23,000 acres of greenbelts and 500 acres of rookeries) over which general public access easements were acquired. These proposed rights are associated with the environmental goal of maintaining or enhancing productivity of the habitat, i.e., allowing the management of timber for fish and wildlife habitat improvement, as well as preserving existing esthetic values to benefit the public access user.

B.3.20. For all real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

B.3.21. Increase Sediment Through Wax Lake Outlet. This feature proposes dredging a new entrance channel from the Atchafalaya River into Wax Lake Outlet at an angle that would optimize sediment transport (Plate B-14).

B.3.22. Canal Closures and Circulation Improvements. This feature proposes the closing of certain canals that permit sediment-laden waters to enter backswamp areas, as well as improving water circulation patterns throughout the lower floodway by the selective opening of dredged material banks and other features that presently impede circulation.

B.3.23. Management Entity. The District Engineer would be the sole jurisdictional authority to protect and oversee Federal interests in the Atchafalaya Basin Floodway System upon implementation of the proposed comprehensive multipurpose plan. Recreation and environmental features of the plan would be operated and maintained by the appropriate Louisiana State agencies under license and lease agreements administered by the Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on special and collateral interests as required by Federal law and Corps of Engineers' regulations.

EVALUATION AND TRADE-OFF ANALYSIS

B.3.24. Plan 4, the EQ plan, makes an average annual contribution of $16,564,000 of tangible nonflood control benefits to the NED account when all nonflood control features are evaluated jointly. Average annual tangible nonflood control costs are $13,521,000 based on 1980 price levels and 7 3/8 percent interest rate. Average annual net benefits, therefore, are $3,043,000 for an overall benefit-cost ratio of 1.2 to 1. This plan has the lowest benefit-cost ratio of any of the final plans. When the nonflood control features of the EQ plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 9.2 to 1 and the benefit-cost ratio for all other nonflood control features is 0.14 to 1. These other nonflood control features are considered to be justified on the basis of intangible environmental benefits they provide. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, are not subject to incremental evaluation.

B.3.25. The EQ plan makes a highly positive contribution to the EQ account because it protects and enhances areas of natural beauty and enjoyment; preserves and enhances valuable biological, ecological, historical, archeological systems; enhances air and water quality by prevention of pollution; and minimizes irreversible commitment of resources to future uses. This plan preserves the most forest and aquatic areas of any plan. Thus it is the top ranking plan in terms of the EQ account.

B.3.26. The EQ plan makes a positive contribution to the social well-being account by preserving the folk culture of the area. It is the highest ranking plan in this account. It makes no appreciable contribution to regional development and, therefore, ranks lowest in this account.

B.3.27. With regard to project-specific planning objectives, the EQ plan accomplishes or exceeds the following:

- Safely passing the project flood and reducing deposition of sediments in the floodway

- Retaining and restoring the unique environmental features of the floodway and maintaining the long-range productivity of wetlands and woodlands

- Allowing agricultural and mineral development without interfering with the natural environment or flood control to the maximum practicable extent

- Maximizing natural delta formation while providing for navigation is accomplished

- Maximizing public opportunity for observing and utilizing fish and wildlife resources of the floodway is met through optimizing public access to aquatic resources by implementation of the proposed recreation features

- Providing additional access to the lower floodway's terrestrial resources.

B.3.28. The impacts of the EQ plan evaluated under the associated evaluation criteria are likely to be unacceptable to the majority of Atchafalaya Basin landowners, hunting clubs, and the commercial fishing interests in Terrebonne Parish. It is, however, likely to be acceptable to commercial fishermen and trappers, conservation groups, and general environmental interests. The completeness of the plan assumes a pre-authorization and post-authorization moratorium on land clearing activities for success in achieving the environmental preservation goals associated with the proposed real estate interests.

B.3.29. For contributions to national planning objectives/accounts, the EQ plan ranks third for the NED objectives, first for the EQ objectives, first for the social well-being objectives, along with the TS plan, and second for the regional development objectives.

Plan 7, National Economic Development (NED) Plan

PLAN DESCRIPTION

B.3.30. This plan is comprised of a number of features which, when considered as a unit, provide for the lowest flowline practicable. These features are discussed in the following paragraphs.

B.3.31. 70/30-Percent Distribution of Flows at Old River. This feature is similar to that described in the EQ plan but includes provisions for variable operation when conditions warrant maintaining 45 feet at Acme, Louisiana, to assist farmers in the Red River backwater area.

B.3.32. Modification of Existing Features, Where Required, to Pass the Project Flood. This component is similar to that discussed in the EQ plan, except that the NED plan provides the lowest practicable flowline, and thus, a grade reduction for the East Atchafalaya Basin Protection Levee, the Atchafalaya River levees, the West Atchafalaya Basin Protection Levee, and the levees west of Berwick is possible.

B.3.33. Bank Stabilization. Bank stabilization measures, such as articulated concrete mattresses and riprap, along the Atchafalaya River at the locations shown on Plates B-15 through B-19 would be required to protect river levees by controlling the meandering of the main channel.

B.3.34. Training Works on the Atchafalaya Basin Main Channel above Morgan City. This feature is identical to that described in the EQ plan, including future maintenance of existing banks, as needed.

B.3.35. Sediment Control. This feature is identical to that described in the EQ plan.

B.3.36. 100/0-Percent Distribution of Outlet Flows. This feature provides for gradually closing Wax Lake Outlet to low and normal flows by constructing a rock weir at the head of Grand Lake, with connecting levees to the West Atchafalaya Basin Protection Levee. All low and normal flows would be conveyed to the Gulf of Mexico by the Lower

Atchafalaya River. For flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that floodflows could be safely conveyed by Wax Lake Outlet to the gulf.

B.3.37. Widening the Wax Lake Outlet Overbank. This component is identical to that described in the EQ plan.

B.3.38. Training Works below Morgan City. This feature provides for training works below Morgan City on both Wax Lake Outlet and the Lower Atchafalaya River and closure of Bayou Shaffer. Construction of the training works would require dredging approximately 15 miles of the existing channel bottom areas and placing the dredged material in adjacent shallow water bottoms or on adjacent stream banks. Gaps between disposal areas would allow for continued development of the overbank wetlands, navigation access, and pipelines (Plate B-20). The pumped material would be allowed to spread freely to the angle of repose, estimated to be 1 vertical on 40 horizontal. The elevation of the placed material would be limited to a height sufficient to confine average annual flows, an approximate average depth of 3 feet. This would result in an irregular series of low mounds of dredged material, positioned parallel to the channels to simulate naturally formed levees.

B.3.39. Extension of Avoca Island Levee. This feature is identical to that described in the EQ plan.

B.3.40. Real Estate Interests. The real estate feature of the NED plan provides only for those interests needed for flood control and recreation development. These components of the NED plan are the same as described for the EQ plan. For all real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

B.3.41. Management Entity. The District Engineer would be the sole jurisdictional authority over flood control features of the plan, and recreational features would be operated and maintained by Louisiana State agencies under license agreements administered by the Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on collateral interests as required by Federal law and regulations.

EVALUATION AND TRADE-OFF ANALYSIS

B.3.42. Plan 7, the NED plan, makes an average annual contribution of $14,236,000 of tangible, nonflood control benefits to the NED account. Tangible, nonflood control costs are $1,717,000 (based on 1980 price levels and 7 3/8 percent interest rate) so that net average

annual benefits are $12,519,000, yielding a benefit-cost ratio of 8.3 to 1. This plan ranks first in meeting NED planning objectives. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, were not incrementally evaluated.

B.3.43. The NED plan makes a negative contribution to most features of the EQ accounts because it does not prevent clearing in the floodway or have the management unit features to protect the aquatic ecosystem. Of all plans, it is ranked lowest in meeting the EQ objective.

B.3.44. The NED plan, which makes a slightly negative contribution to the social well-being account, is ranked lower than the other two plans. Since a positive contribution is made to the regional development account, this plan ranks first in meeting this objective.

B.3.45. With regard to project specific objectives, the NED plan would:

- Safely pass the project flood, but would do so with consequential environmental damages
- Not retain and restore unique environmental features nor maintain productivity of wetlands and woodlands
- Not allow agricultural and mineral development without interfering with flood control and the natural environment
- Not maximize delta development while providing for navigation
- Not meet the specific goal of maximizing public access to the floodway, but optimize public recreation facilities, thereby providing opportunity for use of aquatic resources in the lower basin.

B.3.46. The response of NED plan to associated evaluation criteria is likely to be unacceptable to environmental and commercial fishing interests, sport fishing clubs, and others who support habitat preservation in the floodway. The plan is complete and effective from the standpoint of project flood control protection.

B.3.47. For contributions to national planning objectives/accounts, this plan ranks first for the NED objectives and highest for the regional development objectives, but ranks lowest of the detailed plans considered for EQ and social well-being objectives.

Plan 9b, Tentatively Selected (TS) Plan

PLAN DESCRIPTION

B.3.48. This plan combines features of the EQ plan with features of the NED plan and results in a compatible mix that addresses both national economic development and environmental quality objectives. The features included in this plan are:

- 70/30-percent distribution of flows at Old River (NED)
- Modification of existing features, where required, to pass the project flood (EQ)
- Bank stabilization (NED)
- Training works on the Atchafalaya Basin main channel above Morgan City (EQ)
- Sediment control (EQ)
- 70/30-to approximately 80/20-percent distribution of outlet flows (TS)
- Widening Wax Lake Outlet overbank (EQ)
- Training works below Morgan City (NED)
- Extension of Avoca Island levee (NED)
- Recreation development (EQ)
- Management units (EQ)
- Freshwater structures (EQ)
- Real estate interests (EQ)
- Canal closures and circulation improvements (EQ)
- Management entity (EQ)

All of these features have been described previously, except the 70/30-to approximately 80/20-percent distribution of outlet flows. The letters in parentheses following the feature indicate the plan under which the description appears, e.g., (EQ) indicates environmental quality plan.

B.3.49. 70/30-to Approximately 80/20-Percent Distribution of Outlet Flows. This feature provides for initially maintaining the present distribution of flows at the outlets (70/30), with 30 percent conveyed through Wax Lake Outlet, by constructing a rock weir at the head of Grand Lake, with connecting levees to the West Atchafalaya Basin Protection Levee. As gradual channel development of the Lower Atchafalaya River occurred and if the system responded favorably in terms of the area ecosystem, flow into Wax Lake Outlet would be further restricted by modifying the rock weir to limit low to normal flows entering Wax Lake Outlet to approximately 20 percent. For flows exceeding a 10-year frequency, the low-level levees would be overtopped to allow safe conveyance of floodflows to the gulf.

EVALUATION AND TRADE-OFF ANALYSIS

B.3.50. The TS plan, when all nonflood control features are jointly calculated, makes an average annual contribution of $16,567,000 in tangible nonflood control benefits to the NED account. Tangible nonflood control costs are $12,168,000 (based on 1980 price levels and 7 3/8 percent interest rate) so that net average annual benefits are $4,399,000, and the benefit-cost ratio is 1.4 to 1. Thus, this plan ranks second in meeting NED objectives. When the nonflood control features of the TS plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 9.2 to 1, and the benefit-cost ratio for all other nonflood control features is 0.16 to 1. Despite the excess in costs over tangible NED benefits, the other nonflood control features are considered to be justified and are included in the TS plan because of the intangible environmental benefits they generate.

B.3.51. Because of alternative plan features selected, the TS plan makes a highly positive contribution to all national EQ objectives, a net positive contribution to social well-being, but no net appreciable contribution to regional development objectives.

B.3.52. For the specific planning objectives of safe flood control in an environmentally sound manner, and protection and enhancement of the natural environment, this plan accomplishes these objectives essentially the same as the EQ plan. All other specific planning objectives are met in the same manner as was possible to accomplish by the EQ plan, primarily through the selection of EQ plan features for achieving these goals.

B.3.53. The TS plan's response to associated evaluation criteria will, like the EQ plan, be unacceptable to basin landowners, hunting clubs and commercial fishing interests in Terrebonne Parish, yet be acceptable to fishing clubs, commercial fishermen, and trappers in the floodway.

B.3.54. The geographic scope of this plan is national in nature, and it is reversible to a moderate degree, whereas the NED plan is irreversible like the future without-project condition.

B.3.55. For contributions to national planning objectives/accounts, the TS plan ranks second to the NED plan for achieving national economic development objectives, second to the EQ plan for environmental quality objectives, first for social well-being, and second for regional development objectives. This plan offers the best balance, of all detailed plans considered, toward meeting the national economic objectives and EQ accounts.

Rationale for Designation of EQ Plan

B.3.56. Contributions to environmental quality are favorable changes in the ecological, cultural, and esthetic attributes of natural and cultural resources that sustain and enrich human life (US Water Resources Council, 1980). Most features of the EQ plan would contribute toward environmental quality as defined above, as well as meet the overriding criteria of safely passing the project flood through the Atchafalaya Basin to the Gulf of Mexico. Thus, this plan was designated the EQ plan. The following paragraphs explain how these contributions would occur for each of the EQ plan features yielding a significant environmental quality contribution.

SEDIMENT CONTROL BY DISTRIBUTARY REALINEMENTS

B.3.57. This feature would contribute to preservation of both natural and cultural resources by slowing the rate at which the Lower Atchafalaya Basin Floodway is filling with sediment. This process of sedimentation is destroying wetlands and open water bodies, and this not only reduces aquatic productivity on which many basin-dwellers and recreationists depend, but sedimentation also lowers esthetic values and compounds the loss of cultural resource sites.

MANAGEMENT UNITS

B.3.58. This feature would contribute to preservation of aquatic natural resources by restoring, to the degree practicable, historical water conditions within environmentally and hydrologically distinct areas of the lower floodway. Restoration of water levels in some areas would benefit local residents and recreationists that depend

upon the aquatic productivity of these resources for their livelihood or enjoyment.

FRESHWATER DIVERSION STRUCTURES

B.3.59. These structures would generally provide the same contribution toward environmental quality objectives as would management units, because they would help preserve and improve aquatic natural resources.

CANAL CLOSURES AND CIRCULATION IMPROVEMENTS

B.3.60. These would contribute to improvements in the aquatic environment by helping to prevent introduction of sediment into productive wetland and open water areas and by helping to prevent water quality problems attributed to poor water circulation in swampland areas. These improvements would, in turn, benefit basin-dwellers and recreationists who depend upon aquatic productivity either for livelihood or enjoyment.

REAL ESTATE INTERESTS

B.3.61. Comprehensive multipurpose easements would undoubtedly be the most valuable feature of the EQ plan in terms of contributing to environmental quality objectives. These easements, by preventing clearing of the floodway, controlling the method of cutting timber, and controlling excavation and landfill operations, would preserve much of the ecological productivity of the area on which basin-dwellers and recreationists depend, as well as preserving many of the esthetic attributes that make the basin unique. Likewise, the developmental controls to be obtained for flood control purposes would also serve to protect environmental values of the lower floodway.

RECREATIONAL DEVELOPMENT

B.3.62. These features would contribute to an enrichment of human life by increasing public accessibility to, opportunity for, and enjoyment of the natural and cultural resources of the lower floodway.

DISTRIBUTION OF OUTLET FLOWS: 70/30 LOWER ATCHAFALAYA RIVER/WAX LAKE OUTLET

B.3.63. This feature, to retain present distribution of outlet flows, would contribute to environmental quality by helping maintain the existing ecological trends in the bays south of the project-affected area.

INCREASE SEDIMENT DIVERSION AT WAX LAKE OUTLET

B.3.64. This feature should increase delta development at the mouth of Wax Lake Outlet, which would contribute to environmental quality by increasing the formation of undisturbed marshland in Atchafalaya Bay. Little marshland is presently forming at this location and marshland formation at the mouth of the Lower Atchafalaya River is hampered by the necessity of maintaining a navigation channel through the developing delta.

WIDENING WAX LAKE OUTLET OVERBANK AREA

B.3.65. This feature would greatly improve the ecological conditions of the overbank area by restoring river overflows and tidal influence to its swamps and marshes.

REDUCING BACKWATER FLOODING EAST OF THE FLOODWAY

B.3.66. Extension of the Avoca Island levee is not an EQ feature. It would destroy marsh by direct construction impacts and by increasing the marsh deterioration rate due to reduction of river overflow and it would also contribute to some clearing of forests in the backwater area. On the other hand, it would make a positive contribution to the environment by helping to preserve cypress-tupelo regeneration and farmland in the backwater area. The extension of the Avoca Island levee is the only proposed alternative for solving backwater flooding problems that would be responsive to the legal requirements that an EQ plan be capable of fully achieving project goals throughout the project area. It is for this reason that the levee extension is included in the EQ plan. The plan includes features to fully mitigate environmental losses.

Rationale for Designation of NED Plan

B.3.67. This plan, like the other detailed plans, was developed with the overriding criteria to safely pass the project flood through the Atchafalaya Basin to the Gulf of Mexico. In addition to meeting this criteria, the NED plan specifically attempted to maximize contributions to the NED account for recreation and fish and wildlife resource enhancement, as well as agricultural enhancement. As a result, the plan was comprised of features that would meet these objectives and yet be implementable in terms of the economic, political, social, and environmental systems operating in the area.

B.3.68. Contributions to NED are explained in the following paragraphs for those plan features having a significiant NED contribution.

TRAINING WORKS BELOW MORGAN CITY

B.3.69. This feature would contribute to a lowering of the flowline in the Lower Atchafalaya Basin Floodway, thereby reducing overbank sedimentation and construction costs of other flood control features.

CHANNEL ALINEMENT OF THE AVOCA ISLAND LEVEE

B.3.70. Rationale presented under the EQ plan for the 14,000-foot extension is equally applicable to the NED plan. Additionally, extension of the Avoca Island levee would enhance agricultural development in the backwater area by preventing future rises in backwater flood stages. Selection of the river channel alinement of the Avoca Island levee for this plan was based on its substantially lower construction costs compared to the alternative alinement along the shoreline.

RECREATIONAL DEVELOPMENT

B.3.71. This feature was included because it would generate positive net benefits attributable to the NED account.

100/0-PERCENT DISTRIBUTION OF OUTLET FLOWS

B.3.72. The distribution of outlet flows with no flow through Wax Lake Outlet would increase the total flow capacity of the outlets,

resulting in a lower project flood flowline, and thus, lower construction costs for other flood control features.

REAL ESTATE INTERESTS

B.3.73. Acquisition of easements for purposes other than flood control would not be required, since they would not make positive contributions to the NED account. Acquisition of 1,500 acres of fee land would be required for development of proposed recreation facilities.

Rationale for Tentatively Selected Plan

B.3.74. As with the other plans, this plan meets the overriding criteria of safely conveying the project flood to the gulf. In addition to meeting this criteria, the TS plan offers balance with respect to contributions to both the national economic development and environmental quality accounts. Thus, it would contribute to NED and EQ while being implementable in terms of the economic, political, social, and environmental systems operating in the study area. Table B-3-1 contains a summary of costs, authorization status and purpose of major features of the TS plan.

TABLE B-3-1

COSTS, AUTHORIZATION STATUS, AND PURPOSE OF FEATURES

TENTATIVELY SELECTED PLAN
ATCHAFALAYA BASIN STUDY

Feature	Cost	Requires Congresstional Authorization		Purpose					Remarks
		Yes	No	Flood Control	Environmental Quality	Public Access	Recreation	Agriculture	
Old River Control Structure	No additional		X	X					
Short-term variation of flow	No additional		X		X			X	
Modification of features to pass the project flood	$428,462,000		X	X					
Bank stabilization	$78,600,000		X	X					
Main channel development	$44,300,000		X	X					
Sediment control	$38,100,000		X	X					
Management Units	$21,020,000	X			X				
Real estate interests (445,000 acres)									
Flood Control									
Development Control	$12,197,000	X		X					
Overflow Rights	$5,226,000		X	X					
Environmental	$87,965,000	X			X				
Access	$25,515,000	X				X	X		
Fee	$782,000	X				X	X		
Wax Lake Outlet overbank enlargement (8,000 acres)	$78,600,000		X	X					
Outlet works	$9,422,000		X	X					
Avoca Island levee extension (Backwater flooding east of Morgan City)	$50,394,000		X	X					
Recreational development 1/	$17,450,000	X					X		
Freshwater structures	$7,050,000		X		X				
Canal closures and circulation improvements	$1,000,000	X			X				

REAL ESTATE:
The plan includes comprehensive multi-purpose easements over the entire lower basin that is privately-owned, 445,000 acres excluding developed ridges. In addition, public access rights would be obtained over 103,500 of those same acres, timber rights would be purchased on 73,500 of those same acres and 1,500 acres would be acquired in fee.

COST ALLOCATION OF THE REAL ESTATE PLAN:

Flood Control	$ 17,423,000
Environmental Quality	87,965,000
Public Access	25,515,000
Recreation	782,000
	$131,685,000

1/ Includes $782,000 for fee acquisition of 1,500 acres.

Section 4 - DEVELOPMENT OF FINAL EQ, NED, AND RECOMMENDED PLANS

Changes in Final Plans

B.4.1. Subsequent to the public meetings of July 1981 and coordination of the draft feasibility report/EIS with governmental agencies, businesses, organizations, and the general public, changes were made in all plans. These changes concerned three features: the distribution of flows at Old River control structure, portions of the real estate plan, and backwater flooding east of the lower floodway. The following paragraphs present the rationale for altering each feature.

FLOWS AT OLD RIVER CONTROL STRUCTURE

B.4.2. The NED and TS plans presented in the draft feasibility report/EIS included the possibility of slightly varying the 70/30 distribution at Old River control structure. Some years the structure would be operated to maintain a stage of 45 feet at Acme, Louisiana, during May, June, and July to benefit agricultural interests in the Red River backwater area. During drier years, flows down the Atchafalaya River would be increased to benefit fishery resources in the floodway. Since the public meetings were held, further studies on the possibility of varying flows have shown that operational changes are unacceptable on both engineering and environmental grounds.

B.4.3. Studies to date, including those supporting the authorization of the Old River control structure, and analyses of the behavior of the Atchafalaya and Mississippi Rivers over the period of 1973 to date, have shown that it is necessary to maintain not less than 70 percent of the total annual volume of latitude flow in the channel of the Mississippi River south of the Old River in order to insure that capture of the Mississippi River by the Atchafalaya River does not occur. Day to day departures from the 70/30-percent distribution are possible; but since it is impossible to predict the subsequent hydrograph of latitude flow, the ability to redress the volumetric imbalances created by the departures is limited. In other words, it would be feasible some years to reduce flows through the Old River control structure in order to maintain a stage of 45 feet at Acme for the benefit of agricultural interests as called for in this alternative, but it would probably not be feasible to increase flows

significantly into the Atchafalaya River other years to benefit fishery interests. To increase flow into the Atchafalaya would promote the instability of the Mississippi-Atchafalaya system and enhance the possibility that the Atchafalaya River would eventually capture the Mississippi. If it were not feasible to increase flows into the Atchafalaya River some years to mitigate the low flows of previous years when water was held at 45 feet at Acme, then significant environmental losses would occur in both the Lower Atchafalaya Floodway and in the Red River backwater area. Additionally, other environmental losses would occur even if it were possible to increase flows during drier years. Some of these losses (based upon a worst-case analysis) from both sources are summarized in the following paragraphs.

B.4.4. Induced clearing of about 1,000 acres of bottomland hardwood forest in the Red River backwater area probably would result; and under Plan 7 (NED) conditions, additional clearing of an undetermined amount of forestland in the Lower Atchafalaya Basin Floodway would be induced. Economic losses from the eliminated forest products and from trapping and recreational use of these forest areas would also be anticipated.

B.4.5. Pollution of aquatic habitats in the Red River backwater area and Lower Atchafalaya Basin Floodway would increase due to increased agricultural activity.

B.4.6. A reduction of one-half or more in water exchange within existing aquatic habitat in the Red River backwater area would occur. This action would degrade the aquatic habitat and reduce the standing crop and productivity of fish and other aquatic organisms; thereby, causing a corresponding reduction in economic benefits generated from commercial and recreational fishing.

B.4.7. Overbank flooding would be eliminated during May, June, and July on about 77,000 acres of forest and swampland within the Lower Atchafalaya Basin Floodway by 2030. This reduced flooding would degrade the aquatic habitat and would lead to losses in economic benefits from commercial and recreational fishing. An estimate of the magnitude of these losses to commercial and sport fishing under 2030 conditions in a year when the 45-foot plan would be put into effect is given below:

Species	Annual Pounds Lost
Buffalo	145,000
Catfish	280,000
Crawfish	2,100,000
Sunfish	38,000
Largemouth bass	64,000

These losses to commercial fisheries would result in a loss of net income to fishermen of about $810,000 under these conditions.

B.4.8. Freshwater input into the Atchafalaya delta-Terrebonne marsh complex would be reduced. Since this freshwater input brings with it nutrients and organic matter important in the maintenance of a productive commercial fishery for species such as shrimp, oyster, and menhaden, a corresponding reduction in economic benefits, which would be generated from fishing for these species, would no doubt occur.

B.4.9. An analysis of the economic benefits that would be generated in the form of increased agricultural production and associated damages prevented in the Red River backwater area due to the 45 feet at Acme plan revealed benefits of about $1.4 million annually. This analysis and a partial analysis of environmental impacts in the Red River backwater area was proposed and submitted by the Vicksburg District, US Army Corps of Engineers. (See attachment 1 at the end of this appendix.) Additional material concerning economic and environmental impacts in the lower floodway is on file at the New Orleans District. About half of these benefits would, however, be generated within areas for which previously authorized ring levee systems are being planned--systems which would not cause environmental losses in the lower floodway. Although the measurable economic losses to resources, such as commercial fisheries, in the lower floodway from the 45-foot plan would not equal the benefits to agricultural and related activities, it seems apparent that the total economic losses to all commercial fisheries, both freshwater and marine; the timber industry; and recreational activities would be quite large. Moreover, mitigation measures needed to replace fishery losses generated by the 45-foot plan would be substantial. Because of these facts and because of the constraints which exist with regard to variable operation of the Old River control structure, the feature recommended for all plans is to continue the existing 70/30 operational scheme.

PORTIONS OF THE REAL ESTATE PLAN

B.4.10. The public access interests proposed in the Tentatively Selected Plan of the draft report/EIS were developed in accordance with the 1980 recommendations of the Governor of the State of Louisiana (see attachment 2). During the public meetings of July 1981, general opposition to the "greenbelt" portion of the plan was expressed by landowners and hunters, while environmental interests generally favored "greenbelts." Many landowners voiced opposition to the public access easements and originated an alternate proposition whereby the state would be offered certain lands for acquisition on a "willing seller" basis. These lands, plus those which were included in a donation to the state by the Dow Chemical Company, were proposed as a substitute for the public access easements cited in the draft report. The comprehensive multipurpose easements proposed for flood control and environmental protection over the entire Lower Atchafalaya Basin Floodway were generally supported by both landowners and

environmental groups and remained as part of the landowners' alternative proposal.

B.4.11. Subsequent to the July meetings, a compromise proposal for public access was developed through the cooperative efforts of major opposing interests. Prominent national and local environmental organizations worked with representatives of the landowners and the state toward this end. A key element of the new proposal which makes it acceptable to the environmental community is a recommended tightening of provisions of the comprehensive multipurpose easement to prohibit land use conversion. A key issue resolved by the new proposal is the elimination of the "greenbelts" included under the prior public access proposal. The details of the compromise plan for public access were announced by Governor David C. Treen during a press conference on 19 November 1981, as a substitute for the public access provisions he had recommended in November 1980 and which were presented in the draft report. (See attachment 3 for a summary of the press conference and attachment 4 for the environmental community's proposal for the comprehensive multipurpose easement.

B.4.12. Thus, the Recommended Plan in the final feasibility report/EIS includes this real estate compromise because it is favored by environmental groups, landowners, and the State of Louisiana. The compromise public access plan was not included as part of the EQ plan in the final report/EIS as the 1980 State of Louisiana real estate plan would provide greater protection to the cypress-tupelo swamps by virtue of the purchase of governmental timber rights on 20,000 acres of cypress-tupelo swamp. The compromise plan would allow 217,000 fewer annual user days of recreation by 2030. This lost recreation would be mainly that associated with the "greenbelts." Also, by retaining the 1980 state proposal in the EQ plan, it is possible to compare the impacts of that plan and the compromise plan. Additionally, the comprehensive multipurpose easement was included in the final EQ, as well as the Recommended Plan.

BACKWATER FLOODING EAST OF THE LOWER FLOODWAY

B.4.13. At the time of public release of the draft report, the proposed extension of the Avoca Island levee had been determined to be the only viable alternative for maintaining an equivalent amount of flooding over the entire area of backwater influence east of the Lower Atchafalaya Basin Flooday to generally the level of flooding experienced in that area during the 1945 flood, the protection criterion that the existing levee was provided to meet. The amount of flooding from backwater is dependent on the volume of floodflows conveyed through the floodway system as influenced by the flood control features and the natural alluvial riverine process at work in the basin. The level of flooding from backwater is directly related to

the water level or stage in the Lower Atchafalaya river at the end of the Avoca Island levee. The further development of the delta in Atchafalaya Bay will result in elongation of the course of the river and, thereby, raise the stage at the end of the existing levee for a given discharge. Thus, if the existing levee is not extended, flooding resulting from backwater influences on the area east of the floodway will become more frequent and more severe (greater depths) as the delta develops over time. For this reason, a 14,000-foot extension of the Avoca Island levee was proposed as a feature of the Tentatively Selected Plan in the draft report of 22 June 1981 as an interim measure. This extension was to continue current protection levels for the backwater area.

B.4.14. Because of the dynamic state of development of the delta and the environmental vulnerability of the marsh in the vicinity of the Avoca Island levee, substantial public opposition to extending the levee was expressed during the recent public review of the draft report. Review comments underscored both the environmental values of the Terrebonne marsh to the east of the proposed levee extension and uncertainty concerning potential impacts of the proposed work.

B.4.15. Since the public meetings, the multiple effects of all other proposed flood control features of the plan but excluding the extension of Avoca Island levee have been investigated. The plan feature for widening the Wax Lake Outlet overbank would redistribute flow through the outlets for floods with a probability of occurring less frequently than once in 10 years, and thereby provide for reductions of stages in the Atchafalaya River. Such reductions for the more severe floods serve to reduce backwater flooding in the area east of the floodway.

B.4.16. As described in the draft report, the Avoca Island levee extension is a time-phased construction with the need for adding subsequent extensions directly related to future rises in the project flood flowline. This, in turn, is dependent on conveyance capacity in the Lower Atchafalaya River and accompanying delta development in Atchafalaya Bay.

B.4.17. During the study period to date, a large base of hydraulic and hydrologic engineering data have been generated relative to the analysis and selection of alternatives for improving the conveyance capacity and efficiency of the floodway proper without undue environmental degradation. However, this data base was developed within acceptable confidence limits at the expense of precisely defining all associated hydraulic, hydrologic, and biological parameters in the Atchafalaya Basin outside of the floodway.

B.4.18. Present engineering studies are not of sufficient scope to accurately determine the length of levee extension required to protect the area east of the floodway with the proposed flood control features in place. Ongoing model studies of delta growth will provide a more

reliable basis for making this determination. In addition, further studies are needed for determining changes in subsidence, flow patterns, salinity regimes, and sediment transport within the Terrebonne marshes for the proper assessment of biological and environmental impacts. These studies can be accomplished concurrently with the ongoing model studies.

B.4.19. In summary, further extension of the Avoca Island levee is the only alternative which would provide protection over the entire area of backwater influence east of the floodway; therefore, it remains as a feature of the NED plan. However, more precise engineering and biological parameters must be determined to provide a better understanding of the impacts the recommended flood control features would have on the complex, dynamic, and delicate ecosystem of the bay-marsh complex before implementation of further extensions of the levee and/or other structural or nonstructural features associated with backwater protection can be proposed. The needed studies would be completed by 1985 and a supplemental EIS will be prepared for the specific feature decided upon at that time. Thus, the EQ and the Recommended Plans recommend delaying implementation of any action associated with backwater flooding east of the lower floodway; whereas, the NED plan recommends implementation of the first reach of the Avoca Island levee extension.

FEATURES OF FINAL PLANS

B.4.20. Table B-4-1 summarizes the changes in plans between the draft and final report/EIS. Table B-4-2 delineates the features of the final EQ, NED, and Recommended Plans.

Assessment and Evaluation - EQ Plan

EVALUATION AND TRADE-OFF ANALYSIS

B.4.21. The EQ plan makes an average annual contribution of $18,983,000 of tangible nonflood control benefits to the NED account when all nonflood control features are evaluated jointly. Average annual tangible nonflood control costs are $18,538,000 based on 1981 price levels and 7 5/8 percent interest rate. Average annual net benefits, therefore, are $445,000 for an overall benefit-cost ratio of 1.02 to 1. When the nonflood control features of the EQ plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 8.5 to 1 and the benefit-cost ratio for all other nonflood control features is 0.10 to 1. These other nonflood control

TABLE B-4-1

COMPARISON OF PLANS IN DRAFT AND FINAL REPORT/EIS

Feature	Draft Report/EIS EQ Plan	Final Report/EIS EQ Plan	Draft Report/EIS NED Plan	Final Report/EIS NED Plan	Draft Report/EIS TS Plan	Final Report/EIS Recommended Plan
Flows at Old River Control Structure	Continued 70/30 annual distribution.	Continued 70/30 annual distribution.	70/30 with flows varied, Atchafalaya River flows slightly increased some years and decreased others.	Continued 70/30 annual distribution.	70/30 with flows varied, Atchafalaya River flows slightly increased some years and decreased others.	Continued 70/30 annual distribution.
Prevention of Backwater Flooding	First reach of Avoca Island levee extension.	Delay of implementation until completion of additional studies.	First reach of Avoca Island levee extension.	First reach of Avoca Island levee extension.	First reach of Avoca Island levee extension.	Delay of implementation until completion of additional studies.
Real Estate	1980 State of Louisiana public access and environmental easement proposal.	1980 State of Louisiana public access proposal. 1981 compromise environmental easements.	No public access. Flood control easements only.	No public access. Flood control easements only.	Same as draft EQ.	1981 State of Louisiana public access and environmental easement proposal.

TABLE B-4-2

FEATURE SUMMARY FOR FINAL PLANS

Feature	EQ	NED	Recommended
Flow Distribution at Old River	Existing operational scheme. 70% Mississippi River; 30% Atchafalaya (on annual basis)	Same as EQ.	Same as EQ.
Modifications to Existing Features to Pass Project Flood	As required levee raising, lock mods, pumping plants, etc.	Same as EQ.	Same as EQ.
Training Works on Main Channel Above Morgan City	Confine flows of 450,000 cfs, mile 90.0 to 116.0.	Same as EQ.	Same as EQ.
Sediment Control	Principal distributary realinements.	Same as EQ.	Same as EQ.
Distribution of Outlet Flows	70% LAR/30% WLO (normal flows) Floodflows overtop control	100% LAR/0% WLO (normal flows) Floodflows overtop control	70/30 to 80/20 (gradual shift) Floodflows overtop control
Widening Wax Lake Outlet Overbank	Widen overbank about 3 miles.	Same as EQ.	Same as EQ.
Recreation Development	Camping, boat ramps, and support facilities	Same as EQ.	Same as EQ.
Management Units	Freshwater structures - water level control, circulation improvements.	Not included.	Same as EQ.
Real Estate Interests Flood Control	Flowage and developmental control.	Same as EQ.	Same as EQ.
Environmental Protection	Prohibit land conversion, control timber, flowage, excavation, and fill.	Not included.	Same as EQ.
Public Access	General access, "greenbelts," and timber.	Not included.	Dow donation and willing seller.
Recreation	1,500 acres fee title.	Same as EQ.	Same as EQ.
Increase Sediment through Wax Lake Outlet.	New channel - delta building.	Not included.	Not included.
Canal Closures and Circulation Improvements	Close selected channels and open selected channel blockages.	Not included.	Same as EQ.
Management Entity	NOD District Engineer and state agencies.	Same as EQ.	Same as EQ.
Bank Stabilization	ACM/Riprap	Same as EQ.	Same as EQ.
Training Works Below Morgan City	Not included.	15 miles low mounds.	Same as NED.
Backwater Flooding East of Morgan City	Completion of additional studies prior to implementing levee extensions or other alternative measures.	14,000-foot interim extension of Avoca Island levee and freshwater diversion structure.	Same as EQ.

features are considered to be justified on the basis of intangible environmental benefits they provide. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, are not subject to incremental evaluation.

B.4.22. The statements presented in Section 3 under EQ plan EVALUATION AND TRADE-OFF ANALYSIS are applicable. The social well-being account would be diminished slightly due to delaying implementation of a backwater flooding feature. The objective of safely passing the project flood will be accomplished upon resolution of backwater flooding problems.

MITIGATION REQUIREMENTS

B.4.23. Mitigation requirements of the EQ Plan would arise due to an estimated loss of 200 annualized habitat units (AHU's) of marsh habitat. Since implementation of this plan would result in a net gain of over 400,000 AHU's of bottomland hardwood-open land habitat and almost 3,000 AHU's of swamp habitat, it was assumed that these gains would offset the small loss of marsh habitat. Methods used in calculating mitigation needs are explained in Appendix G.

B.4.24. Cultural Resources. Responsibility to accomplish mitigation of losses of cultural resources is limited to National Register and Register-eligible properties subject to irreparable loss or destruction as the result of activities involving terrain alteration. Mitigation requirements relative to cultural resources cannot be determined at this stage of planning. The only existing project feature that has been subjected to an intensive cultural resources survey is the ongoing enlargement of the Atchafalaya Basin protection levees.

B.4.25. This survey located one archeological site in the probable impact zone, which has been determined to be eligible for inclusion in the National Register. The survey report is in draft form and the effects of the levee raisings upon significant cultural resources is currently being determined. Cultural resource mitigation requirements cannot be fully assessed until the intensive cultural resource surveys of all the selected plan's features are completed. Mitigation requirements will be determined for cultural resources which are determined eligible for inclusion in the National Register that would be adversely affected by the project.

IMPLEMENTATION RESPONSIBILITY

B.4.26. Cost allocation and cost apportionment by project purpose for the EQ Plan are shown in Table B-4-3. As shown in the table, costs are apportioned using the cost-sharing policy proposed by President Carter in his June 1978 water policy message to the Congress and traditional cost-sharing policies. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, and relocations, and a cash contribution of $111,490,000 toward total construction costs. All estimated operation and maintenance costs, except those attributed to mitigation, would be borne by non-Federal interests.

B.4.27. Under traditional cost-sharing policy, all flood control costs are borne by the Federal Government (Section 2 and portions of Sections 3 and 4 of Public Law No. 391, 70th Congress). A non-Federal cash contribution of $2,201,000 toward construction costs of other features would be required in addition to a portion of lands, easements, rights-of-way, and relocations. The operation and maintenance costs attributed to recreation and enhancement of fish and wildlife would be borne by non-Federal interests.

B.4.28. For purposes of determining Federal-state cost-sharing responsibilities, the Atchafalaya Basin is not a traditional water resources development project. Thus, the project should be considered exempt from the traditional policies, the President's cost-sharing policy, and provisions of PL 89-72, 89th Congress, S. 1229, 9 July 1965 under Section 6(e), which states in part that "cost-sharing and reimbursement provisions of the Act shall not apply to non-reservoir local flood control projects," beach erosion control projects, small boat harbor projects, hurricane protection projects, or "to project areas or facilities authorized by law for inclusion within a national recreation area or appropriate for administration by a Federal agency" as part of a national forest system, as part of the public lands classified for retention in Federal ownership, or "in connection with an authorized Federal program for the conservation and development of fish and wildlife." The preauthorization study was authorized by both the House of Representatives and the Senate of the United States, as cited under Study Authority, i.e., "...developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin, Louisiana, which would include...improvements of the area for commercial and sport fishing..."

B.4.29. The Atchafalaya Basin Floodway is a nonreservoir flood control project, but goes far beyond the scope of a local project. The project areas or facilities may become authorized by law to satisfy the intent of the study authority resolution, which directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport

TABLE B-4-3

COST ALLOCATION AND COST APPORTIONMENT FOR ENVIRONMENTAL QUALITY PLAN

Purpose	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1/]		ANNUAL O&M		FIRST COST[1/]		ANNUAL O&M	
	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$596,528,000	$198,843,000	--	$14,439,000	$795,371,000	--	$14,439,000	
Recreation	15,271,000	18,665,000	--	383,000[2/]	16,968,000	$16,968,000	--	$383,000[2/]
Enhancement of Commercial Fish	7,222,000	380,000	--	--	7,602,000	--	--	--
Enhancement of Fish and Wildlife	80,520,000	98,412,000	--	50,000	134,199,000	44,733,000	--	50,000
Mitigation	--	--	--	--	--	--	--	--
TOTALS	$699,541,000	$316,300,000	0	$14,872,000	$954,140,000	$61,701,000	$14,439,000	$433,000

[1/] Interest during construction is not included in costs.

[2/] Based on estimate included in Appendix F.

fishing, as well as commercial fishing potential. The project or facilities are considered appropriate for administration by a Federal or state agency. In view of current administrative policy of placing more responsibility for operation and maintenance of water resource projects in the hands of local authorities, it is proposed that the State of Louisiana take responsibility for operation and maintenance of management units, recreational developments, and lands acquired for public access as included in this plan. Flood control features, dredge and fill (Section 404 and Section 10), and real estate management permits programs will remain under the control of the Corps of Engineers through license and lease agreements with the state.

B.4.30. Lands of the Atchafalaya Basin are not part of a national forest system. However, further justification for exemption of the Atchafalaya Basin Floodway from cost-sharing requirements may be based on the basin's national environmental prominence as one of the largest forested wetlands (river swamp) existing in the United States today that remains in a semi-natural state. The charge for preservation of this vast and irreplaceable resource, while maximizing public opportunity to observe and use its fish and wildlife resources, is clearly beyond the scope of traditional Corps of Engineers water resource development projects. The Governor of the State of Louisiana, in the state's Land-Use Proposal, transmitted by letter 5 November 1980 to the District Engineer, recommended that "...management of non-flood control elements of the final Atchafalaya Basin plan should be through State of Louisiana agencies" (see Attachment 2). This appears to more than satisfy previous legislative and executive intent for assuring local cooperation and participation in Federal flood control projects.

B.4.31. Under a cost-sharing arrangement, described in the preceding paragraphs, the Federal Government would bear a first cost of $999,903,000; and non-Federal interests, a first cost of $15,938,000. Annual operation and maintenance activities costs of $414,439,000 associated with flood control would be borne by the Federal Government. A $33,000 cost for operation and maintenance for recreation and environmental protection and enhancement would be borne by non-Federal interests.

Assessment and Evaluation - NED Plan

EVALUATION AND TRADE-OFF ANALYSIS

B.4.32. The NED plan makes an average annual contribution of $16,551,000 of tangible, nonflood control benefits to the NED account. Tangible, nonflood control costs are $2,055,000 (based on 1981 price levels and 7 5/8 percent interest rate) so that net average

annual benefits are $14,496,000, yielding a benefit-cost ratio of 8.1 to 1. This plan ranks first in meeting NED planning objectives. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, were not incrementally evaluated.

B.4.33. The statements presented in Section 3 under NED plan EVALUATION AND TRADE-OFF ANALYSIS are applicable.

MITIGATION REQUIREMENTS

B.4.34. Fish and Wildlife Habitat. Mitigation needs for the NED plan to replace loss of fish and wildlife habitat would arise due to the estimated loss of about 6,400 annualized habitat units of bottomland hardwood and open land habitat, about 8,500 annualized habitat units of flooded forest, and about 3,000 annualized habitat units of marshland habitat. (If the entire Avoca Island levee extension were built, it would be necessary to replace 19,200 annualized habitat units of marsh, and about 11,000 annualized habitat units of swamp habitat.) Methods used in calculating mitigation needs are explained in Appendix G. The best method to mitigate for the loss of flooded forest habitat and about a third of the swamp habitat would be to build the Buffalo Cove management unit. (This assumes that building the unit would actually benefit aquatic resources.) This action would maintain the present water levels and thus prevent clearing. At the present time, 23,910 acres of early successional bottomland hardwoods and 11,730 acres of cypress-tupelo are flooded yearly in Buffalo Cove. In the future with the NED plan, only 5,100 acres of early successional and 6,120 acres of cypress-tupelo forest would be flooded. Therefore, construction of the management unit would preserve flooding on 18,797 acres of early successional forest with an HQI of 0.27 for a total of 5,075 AHU's preserved. Flooding would also be retained on 5,610 acres of cypress-tupelo forest with an HQI of 0.55 for flooded forest for a total of 3,085 AHU's of flooded forest preserved. This flooding would also preserve about 4,000 AHU's of swamp habitat if one assumes a preservation credit of 1.0 for swampland saved by building the management unit. Thus, construction of the management unit would preserve a total of about 8,200 AHU's of flooded forest habitat and 4,000 AHU's of swamp habitat which would mostly mitigate for the overall 8,500 AHU's loss of flooded forest habitat. To mitigate for the remaining 7,100 AHU's of swamp habitat it might be possible to build a water diversion structure which would direct sufficient Mississippi River water into existing swampland south of the river downstream from Donaldsonville, Louisiana, so that the habitat quality index of the swamps would be raised in a manner similar to that described for the future without-project mitigation plan (see Appendix G). A structure similar to the one described below for marsh habitat mitigation would probably suffice. To mitigate for loss of 6,400 AHU's of bottomland forest-open land habitat it would be

necessary to purchase and manage, as described for the future without-project condition, 16,800 acres of bottomland hardwood habitat. To mitigate for loss of 2,900 AHU's of marshland, it is proposed that management of marsh through freshwater introduction be carried out by diverting water from the Mississippi River into suitable areas adjacent to the river. Costs for these mitigation measures are shown in Table B-4-4.

B.4.35. Cultural Resources. Losses of cultural resources associated with the Recommended Plan would be mitigated in the same manner described in the NED plan.

IMPLEMENTATION RESPONSIBILITY

B.4.36. Cost allocation and cost apportionment by project purpose for the NED plan are shown in Table B-4-5. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, relocations, and a cash contribution of $98,747,000 toward total construction costs. All estimated operation and maintenance costs, except those attributed to mitigation, would be borne by non-Federal interests.

B.4.37. A non-Federal cash contribution of $8,991,000 (based on construction of the first reach of the Avoca Island levee) toward construction costs of other features would be required, in addition to a portion of lands, easements, rights-of-way, and relocations. The operation and maintenance costs attributed to recreation and enhancement of fish and wildlife would be borne by non-Federal interests.

B.4.38. The study authority directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport fishing, as well as commercial fishing potential. Actual basin resource users and those who benefit from such activities transcend state boundaries. As is the case of traditional cost-sharing for flood control, recreation costs should also be borne by the Federal Government. Thus, the Federal Government would be responsible for total first costs of $936,006,000; and non-Federal, $1,875,000. Operation and maintenance costs for flood control, $14,673,000, would be borne by the Federal Government while non-Federal interests would bear annual costs of $383,000 for recreation.

TABLE B-4-4

ESTIMATED MITIGATION COSTS FOR NED PLAN

Action	Total First Costs $	Annual I&A[1] $	Annual O&M[2] $	Total Annual Costs $
Purchase of 16,800 acres of Bottomland Hardwood Forest	13,144,000[3]	1,003,000	25,000[4]	1,028,000
Freshwater Diversion (Swamp)	15,000,000	1,145,000	--	1,145,000
Freshwater Diversion (Marsh)	15,000,000[5] (100,000,000)[6]	1,145,000[5] (7,630,000)[6]	-- --	1,145,000[5] (7,630,000)[6]
Implement Buffalo Cove Management Unit	3,700,000[7]	282,000	10,000	292,000
TOTAL	(46,844,000)[5] (131,844,000)[6]	(3,575,000)[5] (10,060,000)[6]	(35,000) (35,000)	3,610,000[5] (10,095,000)[6]

1/ Interest and Amortization - 7 5/8 percent for 100 years.
2/ Operation and Maintenance.
3/ Based on a unit land cost of $580 per acre, contingency cost of 25 percent, acquisition costs of $4,000 per tract for 110 tracts, development costs of $50 per acre, and total resettlement costs of $20,000.
4/ Assumed to be $1.50 per acre.
5/ Cost for first levee extension only.
6/ Cost for entire levee extension.
7/ Derived from data used in cost estimate preparation for the EQ plan.

TABLE B-4-5

COST ALLOCATION AND COST APPORTIONMENT FOR NATIONAL ECONOMIC DEVELOPMENT PLAN

	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1/]		ANNUAL O&M		FIRST COST[1/]		ANNUAL O&M	
Purpose	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$653,011,000	$217,670,000	--	$14,638,000	$870,681,000	--	$14,638,000	--
Recreation	9,160,000	11,196,000	--	383,000[2/]	10,178,000	10,178,000	--	383,000[2/]
Enhancement of Commercial Fish	--	--	--	--	--	--	--	--
Enhancement of Fish and Wildlife	--	--	--	--	--	--	--	--
Mitigation	35,133,000	11,711,000	26,000	9,000	46,844,000		35,000	--
TOTALS	$697,304,000	$240,577,000	26,000	$15,030,000	$927,703,000	$10,178,000	$14,673,000	$383,000

[1/] Interest during construction is not included in costs; costs based on implementation of 14,000-foot extension of Avoca Island levee.

[2/] Based on estimate included in Appendix F.

Assessment and Evaluation - Recommended Plan

EVALUATION AND TRADE-OFF ANALYSIS

B.4.39. The Recommended Plan, when all nonflood control features are jointly calculated, makes an average annual contribution of $18,659,000 in tangible nonflood control benefits to the NED account. Tangible nonflood control costs are $18,508,000 (based on 1981 price levels and 7 5/8 percent interest rate) so that net average annual benefits are $151,000 and the benefit-cost ratio is 1.01 to 1. Thus, this plan ranks third in meeting NED objectives. When the nonflood control features of the Recommended Plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 8.2 to 1, and the benefit-cost ratio for all other nonflood control features is 0.13 to 1. Despite the excess in costs over tangible NED benefits, the other nonflood control features are considered to be justified and are included in the Recommended Plan because of the intangible environmental benefits they generate.

MITIGATION REQUIREMENTS

B.4.40. Mitigation requirements are the same as for the final EQ plan.

B.4.41. Cultural Resources. Losses of cultural resources associated with the Recommended Plan would be mitigated in the same manner described in the NED plan.

IMPLEMENTATION RESPONSIBILITY

B.4.42. Cost allocation and cost apportionment by project purpose for the Recommended Plan are shown in Table B-4-6. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, and relocations, and a cash contribution of $100,999,000 toward total construction costs. All estimated operation and maintenance costs would be borne by non-Federal interests.

B.4.43. Under the traditional cost-sharing policy, all flood control costs are borne by the Federal Government. No non-Federal cash contribution toward construction costs of other features would be required, but the acquisition of a portion of lands, easements,

TABLE B-4-6

COST ALLOCATION AND COST APPORTIONMENT FOR THE RECOMMENDED PLAN

	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1/]		ANNUAL O&M		FIRST COST[1/]		ANNUAL O&M	
Purpose	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$575,920,000	$191,973,000	--	$15,606,000	$767,893,000	--	$15,606,000	--
Recreation	17,824,000	21,786,000	--	383,000[2/]	19,805,000	19,805,000	--	383,000[2/]
Enhancement of Commercial Fish	7,222,000	380,000	--		7,602,000	--	--	--
Enhancement of Fish and Wildlife	77,805,000	95,096,000	--	50,000	129,676,000	43,225,000	--	50,000
Mitigation	--	--	--	--	--	--	--	--
TOTALS	$678,771,000	$309,235,000	0	$16,039,000	$924,976,000	$63,030,000	$15,606,000	$433,000

[1/] Interest during construction is not included in costs.

[2/] Based on estimate included in Appendix F.

rights-of-way, and relocations would be. Operation and maintenance costs attributed to recreation and enhancement of environmental resources would be borne by non-Federal interests.

B.4.44. The rationale presented for the implementation responsibility for the EQ plan is equally applicable to this plan, based on the selection of alternative features common to both plans. Because this project goes far beyond the scope of a local project in all aspects, particularly its national environmental prominence as one of the largest forested wetlands (river swamp) existing in the United States in a semi-natural state, and the congressional mandate to develop "...a comprehensive plan for the management and preservation of water and related land resources of the Atchafalaya Basin, Louisiana...," the total first cost of $936,797,000 for the project should be borne by the Federal Government with non-Federal interests bearing a cost of $51,209,000. Table B-4-7 shows cost allocation of the nonstructural real estate feature of the Recommended Plan versus what was proposed in the Tentatively Selected Plan. It should be noted that total non-Federal costs incresed from 9 percent to 27 percent, and even though the Recommended Plan total cost increased by over $19 million, the total Federal cost decreased by over $32 million. The annual Federal cost for operations and maintenance of flood control features would be $15,606,000, while non-Federal interests would be responsible for operations and maintenance of recreation facilities and management for environmental resources for fish and wildlife enhancement at an estimated annual cost of $433,000.

TABLE B-4-7

COST ALLOCATION OF NONSTRUCTURAL REAL ESTATE FEATURE
(1 October 1981 Price Levels)

	Tentatively Selected Plan			Recommended Plan		
	Total	Federal	Non-Federal	Total	Federal	Non-Federal
Flood Control	$ 21,510,000	$ 19,635,000	$ 1,875,000[1/]	$19,732,000	$17,857,000	$ 1,875,000[1/]
Environmental	114,866,000	100,803,000	14,063,000[1/]	100,538,000	86,475,000	14,063,000[1/]
Public Access	31,422,000	31,422,000	--	66,693,000	31,422,000	35,271,000[2/]
Recreation	874,000	874,000	--	874,000	874,000	--
Total	$168,672,000	$152,734,000	$15,938,000	$187,837,000	$136,628,000	$51,209,000
Percent of Total	100	91	9	100	73	27

[1/] Credit for cost over 150,000 acres of state land.

[2/] Credit for Dow Chemical Company donation to State of 30,000 acres. = $19,153,000

Cost of "willing seller" fee purchase land of 48,000 acres ($47,540,000) in excess of TS plan public access cost ($31,422,000) = $16,118,000

$35,271,000

Section 5 - COMPARISON OF FINAL PLANS

B.5.1. Comparative information on the final detailed plans and future without-project condition are presented in this section.

Comparison of Detailed Plans

B.5.2. A comparison of the final detailed plans with the future without-project condition is included in the Summary Comparison of Alternative Plans (Table B-5-1). This table provides a summary of significant beneficial and adverse impacts of the alternative plans that were used for the purpose of trade-off analyses and decision making. The table also describes major features of each alternative plan, displays plan response to planning objectives, and presents performance of each plan against specified evaluation criteria.

B.5.3. Structural plans. All of the detailed plans are structural plans. Even the no-action or future without-project plan assumes the continuation of structural works in the form of the Atchafalaya Basin protection levees. This is necessary because of the significance of the floodway in safely passing the project flood via the Mississippi River and its floodway systems.

B.5.4. The detailed plans do not contribute to water conservation for the purpose of beneficial reductions in water uses or water losses. The plans considered in detail do not provide practicable opportunities for water conservation in this sense.

B.5.5. Flood control features were considered to fall under the overall Mississippi River and Tributaries project benefit-cost ratio and consequently were not incrementally evaluated. The nonflood control aspects, when jointly evaluated, were economically justified for all plans. Of the total nonflood control benefits a minimum of 89 percent would accrue to the proposed construction of recreation facilities. The other environmental features, while providing only limited economic benefits, were considered justified on the basis of their intangible benefits and contributions to the study goal of environmental protection.

B.5.6. Overall Versus Incremental Evaluation of Nonflood Control Features. The importance of the recreation development feature to the overall evaluation of nonflood control features is presented in Table B-5-2. The annual benefits generated by the proposed recreation development plan represent approximately 89 percent of the total annual nonflood control benefits of the EQ and Recommended Plans, and

TABLE B-5-1

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
I. PLAN DESCRIPTION					
A. Old River Control (Mississippi River/Atchafalaya River)		70%/30% flow distribution on daily basis.	70%/30% flow distribution on daily basis.	70%/30% flow distribution on daily basis.	70%/30% flow distribution on daily basis.
B. Levees		Levee raising (assumed by local interests).	Levee raising.	Levee raising.	Levee raising.
C. Main Channel		---	Channel training.	Channel training.	Channel training.
D. Sediment Control		---	Distributary realinement.	Distributary realinement.	Distributary realinement.
E. Management Units (MU's)		---	Buffalo Cove and Henderson Pilot Units initially; others possible in future.	No MU's.	Buffalo Cove and Henderson Pilot Units initially; others possible in future.
F. Outlets (Lower Atchafalaya River/Wax Lake)		---	70%/30%; increased sediment, Wax Lake Outlet; widen overbank, Wax Lake Outlet.	70%/30% > 80%/20% > 100%/0%; widen overbank, Wax Lake Outlet; channel training below Morgan City.	70%/30% with possible future control 80%/20%; widen overbank, Wax Lake Outlet; channel training below Morgan City.
G. Backwater Area Northeast of Morgan City		---	Implementation dependent on completing additional studies.	Avoca Island Levee (14,000-foot extension)	Implementation dependent on completing additional studies.
H. Public Recreation		---	Facilities development; increased access as proposed in 1980 State of Louisiana plan.	Facilities development.	Facilities development; increased access as proposed in 1981 substitute plan.
I. Real Estate Interests		Flowage easements only as required by 1936 Flood Control Act.	Flood control easements; environmental easements; recreational fee acquisition (1,500 acres); public acccess easements landowners retain minerals.	Flood control easements; recreational fee acquisition (1,500 acres); landowners retain minerals.	Flood control easements; environmental easements; recreational fee acquisition (1,500 acres); public access on state land; landowners retain minerals.
II. SIGNIFICANT IMPACTS (NET)[1/]					
A. Economic					
1. Agriculture		$5,946,000 average annual net income.	$3,342,000 average annual net income.	$6,805,000 average annual net income.	$3,342,000, average annual net income.
2. Displacement of Farms		Impacts similar to the Recommended Plan.	Impacts similar to the Recommended Plan.	No displacement of agricultural land would occur.	Approximately 7,000 acres of agricultural land in the backwater area northeast of Morgan City would be lost due to rising water levels.
3. Fisheries		$5,820,000 average annual net income.	$6,400,000 average annual net income.	$5,460,000 average annual net income.	$6,400,000 average annual net income.
4. Oil, Gas, and Minerals	Extensive oil, gas, and mineral activities in project-affected area.	No impacts, but oil and gas extraction would become much less important as reserves are depleted.	Impacts similar to the Recommended Plan.	The Avoca Island levee and channel training above and below Morgan City could have adverse impacts on access for exploration and production of oil and gas. Restrictions on structure construction could also cause minor inconveniences.	MU's and nondevelopment easements could cause minor inconveniences with respect to exploration and production of oil and gas.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
5. Prime and Unique Farmlands	Prime is existing farmland in Henderson area. Prime and unique is sugarcane land of backwater and Teche Ridge. Potential unique includes all cypress-tupelo and uncleared ridge areas in backwater.	Rising waters could render 7,000 acres in backwater unavailable for agriculture. Agriculture in Lower Atchafalaya Basin Floodway would increase pollution on thousands of potential unique acres (crawfish ponds).	Impacts similar to the Recommended Plan.	Would preserve 7,000 acres in backwater but clearing in Lower Atchafasaya Basin Floodway would increase pesticide pollution on thousands of acres of potential unique farmland (crawfish ponds).	Rising waters could render 7,000 acres in backwater unavailable for agriculture, but would keep pesticides out of thousands of acres of potential unique farmland (crawfish ponds) in Lower Atchafalaya Basin Floodway.
6. Recreation	269,000 annual user-days of supply valued at $7,469,000.	251,000 average annual equivalent user-days of supply valued at $6,892,000.	1,537,000 average annual equivalent user-days of supply valued at $25,230,000. Real estate features preserve forest and provide access which enhances recreation. Fee acquisition of 1,500 acres provides a large amount of this recreation.	1,320,900 average annual equivalent user-days of supply valued at $23,354,000. Clearing for agriculture and construction impacts, and loss of delta caused by Avoca Island levee would reduce recreation when compared to the EQ or recommended plans. Major source of recreation in this plan is fee acquisition of 1,500 acres.	1,321,000 average annual equivalent user-days of supply valued at $24,944,000. Real Estate features enhance recreation potential and preserve habitats. Intensive development on 1,500 acres fee acquisition provides substantial recreation benefits.
7. Timber	Commercial forests comprise 40 percent of study area. $5,960,000 average annual net income.	Resource would decrease significantly as land clearing continues and harvest of existing cypress forest progresses. $5,410,000 average annual net income.	Resource would decrease slightly from present due to construction impacts. However, resource would be significantly greater than under FWO. $5,474,000 average annual net income.	By 2030, approximately one-fourth of the timber resources in the area would be lost due to clearing. $5,300,000 average annual net income.	Resource would decrease slightly from present due to construction impacts but would be greater than FWO condition. Average annual net income of $5,446,000.
8. Navigable Waterways	Many navigable waterways present, with good access to most areas.	Present conditions would be maintained.	Adverse impacts due to MU's, channel training in the Atchafalaya River, and restriction of Wax Lake Outlet.	Adverse impacts would occur due to channel training in Atchafalaya River and Lower Atchafalaya River, extension of Avoca Island levee and closure of Wax Lake Outlet.	Adverse impacts would occur due to MU's, channel training in the Atchafalaya River and Lower Atchafalaya River, and restriction of Wax Lake Outlet.
9. Wildlife	$185,000 annual net income.	$179,000 average annual net income.	$184,000 average annual net income.	$177,000 average annual net income.	$184,000 average annual net income.
10. Employment		Minor employment opportunities would be provided by levee raising, and conversion of forest to cropland and the development of water-based industry in the vicinity of Krotz Springs. Destruction of fisheries habitat would reduce employment opportunities. Rising stages in backwater area would reduce employment opportunities in business and industry.	Impacts similar to the Recommended Plan.	Essentially the same as FWO except employment opportunities in business and industry would not be lost due to rising stages in the backwater area and water-based industry would not be allowed to develop due to restrictions on the construction of structures.	Minor employment opportunities would be provided by construction of plan features. Employment decline in fishing would be greatly reduced as fisheries habitat is preserved. Rising stages in backwater area would reduce employment opportunities in business and industry. This threat would, however, be moderated compared to FWO as a result of the widening of Wax Lake Outlet. Employment from water-based industry would not occur due to nondevelopmental restrictions in the floodway.
11. Regional Growth	The industrial complex located in and around Morgan City holds the greatest potential for spurring regional growth.	Rising stages in the backwater area would pose a significant hindrance to the growth potential of the Morgan City industrial complex.	Impacts similar to FWO, but with a lesser threat due to the mitigating effect of widening Wax Lake Outlet.	By extending the Avoca Island levee the impediment to industrial expansion and regional growth would be lessened.	Rising stages in the backwater area would pose a significant threat to the growth potential of the Morgan City industrial complex, but is mitigated somewhat by the effects of widening Wax Lake Outlet.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
12. Local Government Finance		The conversion of forestland to cropland could cause the converted acres to be assessed and taxed at a higher rate, increasing the tax base and contributing favorably to tax income. This could also occur with the development of water-based industry in the vicinity of Krotz Springs. However, rising water levels in the backwater area could force the relocation of industrial facilities, thereby reducing the tax base and tax revenue.	Impacts similar to the Recommended Plan.	Same as FWO but to a larger degree with respect to forestland conversion, but not at all with respect to the development of water-based industry due to restrictions on structure construction. Rising water level in the backwater area would be prevented thereby helping to preserve the industrial tax base and tax revenue. There also would be some small increase in sales tax revenue from increased expenditures of recreationists.	Easements associated with this plan would prevent agricultural expansion and the development of water-based industry in the floodway, thereby, preventing the generation of additional tax revenues. Impacts of tax revenues related to the industrial base in the backwater area would be similar to FWO, but less severe. There would also be some small increase in sales tax revenues from incresed expenditures of recreationists.
B. Social					
1. Displacement of People		Displacement would occur as a result of levee raising. Rising water levels in backwater area could cause displacement of residents.	Impacts similar to the Recommended Plan.	Impacts similar to the EQ plan, but with no displacement in the backwater area.	Displacement would occur as a result of levee raising and the widening of Wax Lake Outlet. Rising water levels in the backwater area could also csuse displacements, but this threat would be less than FWO due to the mitigating effect of widening Wax Lake.
2. Community Cohesion	Unique cultural heritage and lifestyles of the Atchafalaya Basin dependent on swamp resource utilization have created strong community cohesion.	The Lower Atchafalaya Basin Floodway would become drier and with the conversion of forest to cropland, it would become increasingly more difficult to preserve traditional lifestyles and communities.	Impacts similar to the Recommaneded Plan.	Impacts essentially the same as FWO, except for a beneficial impact from the Avoca Island levee extension which would prevent water levels from rising in the backwater area, and an adverse impact resulting from increased public access.	Preservation of swamp habitat would help to maintain traditional lifestyles. However, there might be adverse impacts resulting from increased public access, and from rising water levels in the backwater area.
3. Community Growth		The most significant influence on community growth would be the negative effects resulting from rising backwater area stages.	Impacts similar to the Recommended Plan.	This plan removes the hindrance to growth in the backwater area, but would restrict structural development in the floodway.	Reduces hindrance to growth in the backwater area to some degree through the mitigating effects of widening Wax Lake outlet on rising water levels. Floodway growth is restricted through nondevelopmental easements.
4. Health, Safety, and Security of Life	Health, safety, and security of life are currently threatened by the inability of the floodway system to safely pass the design flood.	Levee raising would provide the capability of safely passing the design flood. However, rising water levels in the backwater area would produce adverse impacts to the residents of that area.	Impacts similar to the Recommended Plan.	This plan safely passes the design flood and prevents rising backwater area stages by extending the Avoca Island levee, thereby generating positive impacts.	This plan safely passes the design flood; however, water levels in the backwater area would increase, but to a lesser degree than FWO.
5. Public Facilities and Services		No impacts.	Impacts similar to the Recommended Plan.	Impacts similar to the Recommended Plan.	Increased visitations in the lower floodway resulting from the recreation development plan might necessitate a greater level of public services, e.g., sanitation and law enforcement.
6. Emergency Preparedness	Floodway inadequate to pass major flood. Minor delays in its use could be engendered by existing development in floodway.	Floodway would be able to pass major flood but delays in its use could be engendered by expanded development in the floodway.	Same as the Recommended Plan.	Same as FWO but with fewer potential delays in operation due to restrictions on structure development.	Floodway would be able to pass major flood and restrictions of development would insure that few delays in putting it into operation would occur.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
7. Noise	Area is relatively noise-free compared to other areas. Most existing noise due to boat traffic.	Noise levels temporarily rise during levee raising. Noise levels would increase as agricultural and oil and gas development multiplied. Noise associated with recreation and commercial fishing would decrease.	In southern portion of area, plan would preserve aquatic habitat and boating would increase noise levels over FWO. In northern portion, environmental easement would keep area quieter than under FWO.	Permanent noise would be greatest with this plan due to agricultural development and recreational usage.	In southern portion of area, plan would preserve aquatic habitat and boating would increase noise levels over FWO. In northern portion, environmental easement would keep area quieter than under FWO.
8. Property Ownership	In the Lower Atchafalay Basin Floodway approximately 60 percent of privately-owned land is vested in 13 major property owners. The remaining 175,000 acres are controlled by some 3,200 owners.	Impacts would occur to the extent of land requirements for levee raising.	Impacts similar to the Recommended Plan.	Impacts due to land requirements for construction would be greater than the EQ plan but much less for real estate features, since this plan includes only fee acquisitions and nondevelopment and flowage easements.	In addition to land requirements for plan construction, there would be impacts due to nondevelopment easements, flowage easements, environmental easements, and fee acquisitions in the lower floodway, except for fee purchases from willing sellers for public access and timber ownership easements.
C. Cultural					
1. Culture of the Basin	A unique folk culture, based upon utilization of swamp resources, developed in the basin in the mid-1800's. Although the heart of the swamps has largely been abandoned and the inhabitants have moved to the edges of the floodway, folk traditions, lifestyles and skills remain.	The continuing sedimentation and drainage of the swamps would adversely impact the extractive economy base, and thus, the lifestyle of those who live on the edges of the floodway. This would have far-reaching effects upon folk culture.	This plan would slow the deterioration of the natural conditions upon which the folk culture of the basin is based. However, increased recreational use of the basin would conflict with established commercial use patterns.	This plan would be most detrimental as it would accelerate deterioration of swamp production and thus undercut the economic base of the basin's folk culture. Increased recreational use would cause competition between recreationists and commercial fishermen over the dwindling resource base.	This plan would slow the deterioration of the natural conditions upon which the folk culture of the basin is based. However, increased recreational use of the basin would conflict with established commercial use patterns.
2. Archeological Resources	Over 252 prehistoric and historic archeological sites are recorded. However, these sites represent an incomplete sample of the resources expected to exist.	Archeological resources would be adversely affected as the burial of sites by sedimentation, unregulated development in the basin, the widening and deepening of the Atchafalaya River, and ongoing levee enlargement would continue.	By regulating land development and maintaining natural conditions through MU's, this plan would lessen the processes that adversely impact archeological resources. However, construction related to project features would affect archeological sites and increased public access would increase vandalism and pothunting.	This plan would be the most detrimental to the resource base as it would accelerate the processes which adversely impact archeological resources. Construction related to project features and increased public access would adversely affect archeological resources.	By regulating land development and maintaining natural conditions through MU's, this plan would lessen the processes that adversely impact archeological resources. However, construction related to project features would affect archeological sites and increased public access would increase vandalism and pothunting.
3. National Register Properties	Two cultural resources have been determined eligible for the National Register of Historic Places. Ten additional significnt cultural resources possibly eligible for inclusion in the National Register also exist.	The ongoing levee enlargement would possibly impact one of the two National Register-eligible properties and six of the additional 10 cultural resources identified as possibly eligible for the National Register.	Same as FWO except that other project features would possibly impact additional cultural resources identified by future investigations as eligible for the National Register.	Impacts similar to the EQ plan.	The ongoing levee enlargement would possibly impact one of the two National Register-eligible properties and six of the additional 10 cultural resources identified as possibly eligible for the National Register. Other project features would possibly impact additional cultural resources identified by future investigations as eligible for the National Register.
D. Environmental					
1. Physical Land Features and Geology	Alteration of physical land features by sedimentation deposits.	Up to 9 feet of sedimentation will be deposited in areas of the Lower Atchafalaya Basin Floodway.	Sedimentation control measures will minimize impacts to the extent practicable.	Same as the EQ plan.	Sedimentation control measures will minimize impacts to the extent practicable.

TABLE B-S-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
2. Biological Resources					
a. Audubon Society Blue List Species	Range of 50 species includes project area.	Species living in forests or marshes would decline in numbers as the habitat declines.	Plan would benefit forest species.	Plan would be greatly detrimental to most species--especially those inhabiting forests and brackish and saline marshes. Increased pollution caused by agriculture would also have adverse impacts.	Plan would benefit forest species.
b. Early Successional Bottomland Hardwoods	93,900 acres	35,700 acres in 2030. Bulk of 58,200-acre loss due to clearing for agriculture.	58,500 acres in 2030. 35,400-acre loss from base mostly due to plant succession. 22,800-acre gain over FWO.	42,100 acres in 2030. 51,800-acre loss from base mostly due to land clearing. 6,400-acre gain over FWO.	60,400 acres in 2030. 33,500-acre loss from base mostly due to plant succession. 24,700-acre gain over FWO.
c. Mid-to-Late Successional Bottomland Hardwoods	332,000 acres	186,000 acres 146,000-acre loss mostly due to land clearing for agriculture.	339,000 acres in 2030 153,000-acre gain over FWO due to environmental easements.	178,000 acres in 2030 154,000-acre loss from base mostly due to land clearing. 8,000-acre loss from FWO due to land clearing.	339,000 acres in 2030 153,000-acre gain over FWO due to environmental easements.
d. Cypress-Tupelo Swamps	451,000 acres	415,000 acres in 2030. 36,000-acre loss mostly due to land clearing.	408,800 acres in 2030 Impacts similar to the Recommended Plan.	364,000 acres in 2030 87,000-acre loss from base due to land clearing and plant succession. 51,000-acre loss from FWO mostly due to land clearing and plant succession.	408,000 acres in 2030 42,800-acre loss from base mostly due to plant succession. 7,000-acre loss from FWO mostly due to plant succession.
e. Fresh Marshes	321,000 acres	243,000 acres in 2030 78,000-acre loss due mostly to existing marsh deterioration trends.	243,000 acres in 2030 79,000-acre loss from base. 300-acre loss from FWO mostly due to direct construction impacts.	239,000 acres in 2030 83,000-acre loss from base. 5,000-acre loss from FWO, mostly due to accelerated marsh loss caused by Avoca Island levee.	242,000 acres in 2030 79,000-acre loss from base. 1,000-acre loss from FWO, mostly due to direct construction impacts of channel training below Morgan City.
f. Brackish Marshes	89,000 acres	64,000 acres in 2030 25,000-acre loss due to marsh deterioration.	64,000 acres in 2030 Impacts similar to the Recommended Plan.	63,200 acres in 2030 26,000-acre loss over base. 1,200-acre loss over FWO, Avoca Island levee causes accelerated marsh loss.	64,000 acres in 2030 25,000-acre loss over base due to marsh deterioration. No change from FWO.
g. Saline Marshes	107,000 acres	69,000 acres in 2030 38,000-acre loss due to marsh deterioration.	67,000 acres in 2030 Impacts similar to the Recommended Plan.	69,000 acres in 2030 38,000-acre loss from base. 100-acre loss from FWO due to accelerated marsh loss caused by Avoca Island levee.	69,000 acres in 2030 38,000-acre loss from base due marsh deterioration. No change from FWO.
h. Atchafalaya Bay Delta	10,100 acres	135,000 acres in 2030 125,000-acre gain due to delta development in Atchafalaya Bay.	135,000 acres in 2030 125,000-acre gain over base. Same as FWO.	131,000 acres in 2030 121,000-acre gain over base. 4,000-acre loss from FWO due to Avoca Island levee. Between 2030 and 2080 an additional 17,000 acres of delta would deteriorate due to the Avoca Island levee.	135,000 acres in 2030 125,000-acre gain over base due to delta development in Atchafalaya Bay.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
i. Fisheries	The overflow system of Lower Atchafalaya Basin Floodway supports a fishery rich in numbers and species. Crawfish harvest averages 15 million pounds yearly. Marshes support an important estuarine fishery. Annual harvest of shrimp is 47.8 million pounds; menhaden is 173 million pounds.	Fisheries productivity would decline from present due to loss of aquatic habitat because of sedimentation and lowering of water levels. Agriculture would increase sediments and pesticides in the aquatic system. Crawfish maximum sustainable yield would drop 39 percent from present.	Impacts similar to the Recommended Plan.	Overall fishery productivity would be lowest with this plan. Sedimentation would destroy thousands of acres of aquatic habitat in the Lower Atchafalaya Basin Floodway and severe water quality problems would occur. Additional agriculture would increase pesticides and sediments, which would reduce fisheries. Crawfish maximum sustainable yield would drop 48 percent from present. Avoca Island levee alinement would cause greatest loss of estuarine fisheries of any plan. Widening of Wax Lake Outlet and construction of 11,610 acres of borrow pits would have benefits described in the EQ plan.	Overall fishery productivity would be less than present, but more than under FWO or NED plan. MU's would increase fishery productivity by flooding more land deeper and longer than under FWO condition, and by preserving permanent aquatic habitat at low water. Crawfish maximum sustainable yield would drop 28 percent from present. Estuarine fishery resources would decrease slightly from present and FWO. Widening Wax Lake Outlet overbank would benefit fisheries by reconnecting 7,800 acres of cypress-tupelo to river and tidal system. 11,950 acres of borrow pits would be created which would enhance fisheries.
j. Endangered and Threatened Species	Sixteen endangered or threatened species occur or might be expected to occur in project area.	Six species would be affected adversely.	Two species would be benefited and two species adversely affected.	Same as FWO.	Two species would be benefited and two species adversely affected.
k. Rookeries	Numerous rookeries occur in the project-affected area.	A number would disappear due to decline in feeding habitat for birds that use them.	Impacts similar to the Recommended Plan.	No protection by easements. Least feeding habitat of any plan would be preserved. Recreational impacts same as the EQ Plan. Clearing would cause increased pesticide pollution in aquatic areas which would adversely impact birds. Channel training of the Lower Atchafalaya River could disrupt several sites.	Five hundred acres of rookeries would be protected by special easements. Environmental easements and MU's would preserve feeding habitat for birds. Recreation features would increase public use, causing increased harassment of birds during nesting. In addition, channel training of the Lower Atchafalaya River could disrupt several sites.
l. Wildlife	A great variety of wildlife exists throughout the project area.	A highly significant decrease in wildlife would occur due to destruction and degradation of forests, marshes and aquatic habitats due to clearing for agriculture, sedimentation, and levee raising.	Impacts similar to the Recommended Plan.	A highly significant decrease in wildlife would occur due to loss of forestland in the Lower Atchafalaya Basin Floodway and backwater area, marsh deterioration and direct construction impacts.	A slight decrease in wildlife would occur due to marsh deterioration, and direct construction impacts. However, there would be a gain in wildlife over FWO conditions.
3. Air Quality	Quality is generally good except near industrial facilities.	Quality would decrease as development and agricultural expansion spread.	Existing quality would be preserved.	Quality would deteriorate throughout the area but not as much as under FWO.	Existing quality would be preserved.
4. Water Quality	River water is high in suspended sediments, dissolved oxygen and nutrients. Overbank areas experience low dissolved oxygen levels during much of the year. Nutrients are sufficiently available within the lower floodway for complete bacterial metabolism of organic matters. Areas outside of floodway have higher dissolved oxygen and more phytoplankton production.	Water quality in overbank areas would deteriorate as average levels and circulation decrease. Further sedimentation would cause even lower dissolved oxygen. Increases in agriculture and industrial would lead to potential problems of pesticide and heavy metal concentrations.	Impacts similar to the Recommended Plan.	Channel training and outlet flow concentration through the Lower Atchafalaya River would lower flowline. Absence of MU's, together with other features, would reduce overbank water supplies. Avoca Island levee extension would limit freshwater input to Terrebonne marshes, but diversion structure(s) could compensate for this effect.	MU's would maintain desirable water levels and flow patterns. Sedimentation would be reduced by distributary realinement. Environmental easements would prevent water quality problems associated with agricultural and industrial development. Possible flow distribution between Wax Lake Outlet and Lower Atchafalaya River, along with channel training, would result in lessened overbank flow into adjacent marshes.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
5. Esthetic Values	Value high due to semiwilderness nature of area despite oil and gas activities.	Quality would continue to deteriorate as sedimentation continues to fill in open water areas and as oil and gas activity expands and logging accelerates.	Impacts similar to the Recommended Plan.	Even greater degradation of esthetic values in Lower Atchafalaya Basin Floodway and Atchafalaya Bay would occur than under FWO. Construction of Avoca Island levee through center of developing delta would degrade esthetics.	Values would decline from present as sedimentation, and oil and gas activities continue and logging accelerates. Decline would be far less than under FWO. Real estate features would preserve forests in Lower Atchafalaya Basin Floodway. Overall plan would benefit esthetic values, except channel training along the Lower Atchafalaya River and Wax Lake Outlet would degrade esthetics.
6. Open and Green Space	Largest contiguous, roadless, semiwilderness in Louisiana.	Amount and quality of open space in Lower Atchafalaya Basin Floodway would decrease while need for such spaces grew. Rising water levels would preserve open space in backwater area. Continued oil development would decrease quality.	Open space preserved in Lower Atchafalaya Basin Floodway and backwater area.	Greatest amount of open space, both in Lower Atchafalaya Basin Floodway and backwater area, would be lost.	Open space preserved in Lower Atchafalaya Basin Floodway and backwater area.
7. Lakes and Streams					
a. Riverine and Distributary Waters	31,100 acres	32,000 acres in 2030 1,000-acre gain over base due to erosion of Atchafalaya River.	33,000 acres in 2030 2,000-acre gain over base due to construction and erosion. 1,000-acre gain over FWO due to construction.	32,000 acres in 2030 1,000-acre gain from base due to erosion. Same as FWO.	32,000 acres in 2030 1,000-acre gain from base due to erosion. 100-acre gain from FWO due to construction.
b. Bayous, Canals, and Borrow Pits	38,000 acres	51,000 acres in 2030 13,000-acre gain due mostly to levee raising and some to marsh deterioration.	51,000 acres in 2030 13,000-acre gain over base mostly due to levee raising and some to marsh deterioration. 100-acre gain over FWO due to construction impacts.	53,000 acres in 2030 15,000-acre gain over base due mostly to levee raising and some marsh deterioration. 1,700-acre gain over FWO due to construction impacts of the Avoca Island levee extension.	51,000 acres in 2030 12,700-acre gain over base due mostly to levee raising and some marsh deterioration. 200-acre gain over FWO due to construction impacts.
c. Headwater Lakes	18,200 acres	1,900 acres in 2030 16,300-acre loss due mostly to sedimentation and lowering of water levels.	2,200 acres in 2030 Impacts similar to the Recommended Plan.	1,800 acres in 2030 16,400-acre loss from base due to sedimentation and falling water levels. 100-acre loss from FWO.	2,200 acres in 2030 16,000-acre loss from base due to sedimentation and falling water levels. 300-acre gain over FWO.
d. Backwater Lakes	42,000 acres	34,000 acres in 2030 8,000-acre loss due mostly to sedimentation and falling water levels and 3,900 acres reclassified as cropland lakes due to clearing.	38,300 acres in 2030 3,700-acre loss from base due to sedimentation and falling water levels. 4,300-acre gain over FWO due mostly to environmental easements.	33,400 acres in 2030 8,600-acre loss from base due to sedimentation and falling water levels and about 4,600 acres reclassified as cropland lakes due to clearing.	38,300 acres in 2030 3,700-acre loss from base due to sedimentation and falling water levels. 4,300-acre gain over FWO due mostly to environmental easements.
e. Cropland Lakes	30 acres	4,100 acres 4,070-acre gain due to land clearing.	30 acres in 2030 Retains present conditions.	4,900 acres in 2030 4,870-acre gain over base due to land clearing. 800-acre gain over FWO due to land clearing.	30 acres in 2030 Retains present conditions.
f. Brackish and Saline Marsh, Bayous, and Canals	Brackish bayous 6,200 acres. Saline bayous 6,100 acres.	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Increase due to erosion of brackish and saline marsh.	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Same as FWO.	Brackish 8,300 acres by 2030. Saline 7,400 acres by 2030. Saline same as FWO, additional brackish marsh deterioration caused by Avoca Island extension would lead to increase of 200 acres of brackish bayous.	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Increase due to erosion of brackish and saline marsh.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
g. Marsh Ponds and Lakes	Fresh 87,600 acres. Brackish 55,200 acres. Saline 64,400 acres.	Same as the Recommended Plan.	Same as the Recommended Plan.	Fresh 142,400 acres in 2030. Brackish 76,300 acres in 2030. Saline 99,100 acres in 2030. Gains slightly larger than FWO. Construction of Avoca Island levee would increase formation of ponds.	Fresh 141,600 acres in 2030. Brackish 75,300 acres in 2030. Saline 99,000 acres in 2030. 54,000-acre gain of fresh, 20,[illegible] acre gain of brackish, 34,600-acre gain of saline due to "natural" deterioration of marsh.
h. Bays and Open Gulf	Fresh bays 200,000 acres. Brackish bays 58,900 acres. Saline bays 53,800 acres. Shallow gulf 804,000 acres.	Fresh bays 75,700 acres in 2030. Others same as base. Loss of 124,300 acres of fresh bays due to growth of delta in Atchafalaya Bay.	78,900 acres of fresh bays in 2030. Impacts similar to the Recommended Plan.	79,700 acres of fresh bays in 2030. Others same as base. Loss of 120,300 acres of fresh bays due to growth of delta in Atchafalaya Bay.	78,900 acres of fresh bays in 2030. Others same as base. Loss of 121,100 acres of fresh bays due to growth of delta in Atchafalaya Bay.
8. Wildlife Refuges and Management Areas	One national refuge and 11 state management areas in project area. Two in project-affected area.	The two management areas in the project-affected area would increase in size and terrestrial habitat quality due to sedimentation and plant succession. Aquatic habitat quality would decrease due to pollution.	Public use would be increased in the two areas in project-affected area.	Public use would be increased as in the EQ plan. Channel alinement of Avoca Island levee could destroy 4,000 acres of newly developed delta in Atchafalaya Delta Management Area by 2030 and an additional 17,000 acres by 2080.	Public use would be increased in the two areas in project-affected area.
9. Natural and Scenic Streams	Bayou Penchant	Scenic quality could decrease or change as water levels rise due to rising Atchafalaya River flowline.	Same as FWO.	Avoca Island levee would prevent rising water levels and possibly help preserve existing scenic quality.	Scenic quality could decrease or change as water levels rise due to rising Atchafalaya River flowline.
III. PLAN EVALUATION					
A. Contribution to National Planning Objectives/Accounts					
1. National Economic Development[2/]					
a. Tangible Annual Benefits (Nonflood Control)		No contribution.			
(1) Recreation Development			$17,273,000	$16,551,000	$16,551,000
(2) Other Nonflood Control Features			$ 1,710,000	$ 0	$ 2,108,000
(3) Total Nonflood Control			$18,983,000	$16,551,000	$18,659,000
b. Tangible Annual Costs (Nonflood Control)		No contribution.			
(1) Recreation Development			$ 2,029,000	$ 2,055,000	$ 2,029,000
(2) Other Nonflood Control Features			$16,509,000	$ 0	$16,479,000
(3) Total Nonflood Control			$18,538,000	$ 2,055,000	$18,508,000

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
c. Net Benefits (Nonflood Control)		No contribution.			
(1) Recreation Development			$15,244,000	$14,496,000	$14,522,000
(2) Other Nonflood Features			-$14,799,000	$ 0	-$14,371,000
(3) Total Nonflood Control			$ 445,000	$14,496,000	$ 151,000
d. Benefit-Cost Ratio (Nonflood Control)		No contribution.			
(1) Recreation Development			8.5 to 1	8.1 to 1	8.2 to 1
(2) Other Nonflood Control Features			0.10 to 1	--	0.13 to 1
(3) Total Nonflood Control			1.02 to 1	8.1 to 1	1.01 to 1
2. Environmental Quality					
a. Management, Protection, Enhancement, or Creation of Areas of Natural Beauty and Enjoyment		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
b. Management, Preservation, or Enhancement of Especially Valuable or Outstanding Archeological, Historical, Biological, and Geological Resources and Ecological Systems		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
c. Enhancement of Quality Aspects of Water, Land, and Air by Control of Pollution or Prevention of Erosion and Restoration of Eroded Areas		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
d. Avoiding Irreversible Commitment of Resources to Future Uses		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
3. Social Well-Being		Net negative contribution.	Positive contribution in floodway; negative contribution in backwater.	Slightly negative contribution.	Positive contribution in floodway; negative contribution in backwater.
4. Regional Development		No net appreciable contribution.	Same as FWO.	Positive contribution	No net appreciable contribution.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
B. Contribution to Specific Planning Objectives					
1. Flood Control-Implement a Flood Control System That Will Safely Pass the Project Flood to the Gulf of Mexico in an Environmentally-Sound Manner. Reduce to the Maximum Extent Practical the Deposition of Sediments That Reduce the Ability of the Floodway to Pass the Project Flood.		Will pass the project flood with consequential damages.	Will accomplish objective upon resolution of backwater flooding problem.	Will safely pass the project flood with more environmental damages than FWO.	Will accomplish objective upon resolution of backwater flooding problem.
2. Natural Environment--Retain and Restore the Unique Environmental Features of the Floodways and Maintain or Enhance the Long-Range Productivity of the Wetland and Woodlands.		Does not accomplish objective.	Of all alternative plans considered, most nearly achieves the objective.	Same as FWO.	Of all alternative plans considered, most nearly achieves the objective.
3. Agricultural Activities and Mineral Development--Allow Agricultural Activities and Mineral Development Provided Such Activity Does Not Interfere with the Goals Relative to Flood Control or the Natural Environment.		Does not accomplish objective.	Same as FWO.	Same as FWO.	Does not accomplish objective.
4. Delta Formation--Maximize Natural Delta Formation in Atchafalaya Bay While Providing for Navigation and Passage of the Project Flood.		Accomplishes objective.	Same as FWO.	Does not accomplish objective.	Accomplishes objective.
5. Public Accessibility Maximize Public Opportunity to Observe and Utilize the Fish and Wildlife Resources of the Floodway.		Does not accomplish objective.	Optimizes pubilc access to aquatic resources. Provides more limited terrestrial access.	Does not meet specific intent of objective but optimizes public access to aquatic resources.	Optimizes pubilc access to aquatic resources. Provides more limited terrestrial access.
C. Plan Response to Associated Evaluation Criteria					
1. Acceptability		Unacceptable to flood control and environmental interests alike.	Unacceptable to many basin landowners, hunting clubs. Acceptable to environmental interests.	Unacceptable to environmental and commercial fishing interests.	Acceptable to most basin landowners, commercial fishing interests, and Terrebonne Parish. Unacceptable to some hunting clubs.
2. Completeness		Assumes some state or local entity would implement flood control actions to pass project flood in the absence of Federal action.	Assumes preauthorization and post-authorization moratorium on land clearing.	Complete	Assumes preauthorization and post-authorization moratorium on land clearing.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
3. Effectiveness		Effective for project flood conveyance (see "Completeness" above).	Effective for flood conveyances and environmental protection.	Effective for project flood conveyance.	Effective for flood conveyances and environmental protection.
4. Certainty		Certainty is low with respect to flood control and moderate regarding environmental quality.	Certainty is high.	Certainly is high with respect to flood control and low with respect to environmental quality.	Certainty is high.
5. Geographic Scope		Scope is national in nature.	Same as FWO.	Same as FWO.	Scope is national in nature.
6. NED Benefit-Cost Ratio (Overall Nonflood Control)			1.02 to 1	8.1 to 1	1.01 to 1
7. Reversibility		Irreversible.	Reversible to a moderate degree.	Same as FWO.	Reversible to a moderate degree.
8. Stability		Same as the Recommended Plan.	Medium to high	Same as FWO.	Because of the dynamic nature of the basin ecosystem, the overall stability associated with this condition falls in the median percentile.
D. Rankings of Plans					
1. NED Objective			(2)	(1) NED Plan	(3)
2. EQ Objective			(1) EQ Plan	(3)	(2)
3. Social Well-Being Objective			(1)	(2)	(1)
4. Regional Development Objective			(2)	(1)	(2)
IV. IMPLEMENTATION RESPONSIBILITY					
A. Total First Cost Flood Control and Nonflood Control[3/]					
1. Federal			$ 999,903,000	$936,006,000	$936,797,000
2. Non-Federal[4/]			15,938,000	1,875,000	51,209,000
3. Total			$1,105,841,000	$937,881,000	$988,006,000
B. Annual Operation and Maintenance Cost (Flood Control and Nonflood Control)[3/]					
1. Federal			$ 14,439,000	$ 14,673,000	$ 15,606,000
2. Non-Federal			433,000	383,000	433,000
3. Total			$ 14,872,000	$ 15,056,000	$ 16,039,000

1/ For purposes of comparing impacts of the detailed plans on an equal basis, the Avoca Island levee extension and five management units were assumed in place. The implementation of only an additional 14,000 feet of the Avoca Island levee would cause minimal impacts.

2/ The benefits and costs presented here are the nonflood control values applicable to each plan alternative. The flood control aspects of each plan are considered a part of the overall Mississippi River and Tributaries project and as such are not subject to incremental evaluation.

3/ Based on construction of an additional 14,000 feet of the Avoca Island levee for the NED plan; does not include interest during construction for any plan.

4/ Includes credit for flood control and/or basic environmental easements over 150,000 acres of state-owned land.

in the case of the NED plan, these benefits represent 100 percent of the total.

TABLE B-5-2

RECREATION DEVELOPMENT BENEFITS AS A PERCENT OF TOTAL NONFLOOD CONTROL BENEFITS

	NED	EQ	Recommended
Total Annual Nonflood Control Benefits	$16,551,000	$18,983,000	$18,659,000
Annual Recreation Development Benefits	$16,551,000	$17,273,000	$16,551,000
Recreation Development As a Percent of Total	100	91	89

B.5.7. The fact that the recreation development feature accounted for most of the total benefits suggests that this feature should be considered as a separable feature and evaluated incrementally. In the case of the NED plan, the evaluation of nonflood control features has produced an incremental evaluation of the recreation development feature. This is because it represents the only nonflood control feature of the NED plan. In addition to accounting for approximately 90 percent of total benefits, the fact that these benefits could be achieved by construction of only those features associated with the recreation development plan adds significantly to the case for incremental evaluation. Fee purchase of approximately 1,500 acres and construction of facilities on these acres would be the only requirements for the plan to be effective. Purchase of additional real estate easements to provide public access or to protect fish and wildlife habitat would not be necessary for the proposed recreation features to achieve the stated level of benefits.

B.5.8. Table B-5-3 presents an incremental evaluation of the recreation development plan, assuming all other nonflood control features in place. As was suggested by the high percentage of total benefits represented by recreation, the incremental evaluation produced a highly favorable economic justification. (It should be noted that the 1,500 acres required for construction of recreation facilities would result in only very minor losses to timber and recreational hunting. For purpose of incremental analysis, this would slightly increase the cost of the development plan.) Table B-5-4 presents an evaluation of the remaining nonflood control features exclusive of the development plan. With annual benefits approximately

90 percent less, while still carrying the majority of the annual costs (approximately 89 percent for both the EQ and Recommended Plans), the remaining nonflood control features lacked tangible economic justification.

TABLE B-5-3

INCREMENTAL EVALUATION OF RECREATION DEVELOPMENT ONLY

	NED	EQ	Recommended
Annual Benefits	$16,551,000	$17,273,000	$16,551,000
Annual Costs	$2,055,000	$2,029,000	$2,029,000
Benefit-Cost Ratio	8.1 to 1	8.5 to 1	8.2 to 1

TABLE B-5-4

INCREMENTAL EVALUATION OF NONFLOOD CONTROL FEATURES EXCLUDING RECREATION DEVELOPMENT

	EQ	Recommended
Annual Benefits	$1,710,000	$2,108,000
Annual Costs	$16,509,000	$16,486,000
Benefit-Cost Ratio	0.10 to 1	0.13 to 1

B.5.9. The inclusion of the recreation facilities development in the overall evaluation of nonflood control features results in an economically justified plan in tangible economic terms. When included, the EQ and Recommended Plans yield benefit-cost ratios of 1.02 to 1 and 1.01 to 1, respectively. In their absence, the EQ and Recommended Plans fall to 0.10 to 1 and 0.13 to 1, respectively. These other nonflood control features, however, have been included in the Recommended Plan because of the significant contribution they make to the EQ account. While providing only limited tangible economic benefits, these features are considered justified on the basis of their intangible benefits and their contributions to the study goal of environmental protection.

B.5.10. Table B-5-5 summarizes the costs, authorization status, and purposes of the features included in the Recommended Plan. Plate B-21 delineates the features geographically.

TABLE B-5-5

COSTS, AUTHORIZATION STATUS, AND PURPOSE OF FEATURES

RECOMMENDED PLAN
ATCHAFALAYA BASIN STUDY

Feature	Cost	Requires Congressional Authorization		Purpose				Remarks
		Yes	No	Flood Control	Environmental Quality	Public Access	Recreation	
Old River Control Structure, maintain present operation	No additional		X	X				
Modification of features to pass the project flood	$446,681,000		X	X				
Bank stabilization	$104,950,000		X	X				
Main channel development[1/]	$64,100,000		X	X				
Sediment control	$31,100,000		X	X				
Management Units	$23,730,000	X			X			
Real Estate Interests								REAL ESTATE: The Recommended Plan includes comprehensive multipurpose easements over 367,000 acres in the Lower Atchafalaya Basin Floodway, excluding developed ridges. In addition, public access rights would be provided in the lower floodway by the State of Louisiana on: 150,000 acres of existing state lands; more than 30,000 acres donated to the state by Dow Chemical Company; and by the fee title purchase of approximately 50,000 acres of lands identified by the state, with Federal cost participation.
Flood Control								
Development Control	$13,781,000	X		X				
Overflow Rights	$5,951,000	X		X				
Environmental	$100,538,000	X			X			
Access	$66,693,000	X				X	X	
Fee (Recreation)	$874,000	X				X	X	
Wax Lake Outlet overbank enlargement (8,000 acres)	$90,500,000		X	X				COST ALLOCATION OF THE REAL ESTATE PLAN:
Outlet Works	$10,830,000		X	X				Flood Control $19,732,000 Environmental Protection 100,538,000 Public Access 66,693,000 Recreation (1,500 acres) 874,000 $187,837,000
Backwater Flooding East of Morgan City[2/]	—		X	X				
Recreational Development	$19,169,000	X					X	
Freshwater Structures	$8,109,000		X		X			
Canal Closures and Circulation Improvements	$1,000,000	X			X			
TOTAL[3/]	$988,006,000[4/]							

[1/] Includes channel training below Morgan City at $11,650,000.

[2/] Implementation after completing additional engineering and biological studies.

[3/] Does not include interest during construction.

[4/] Federal cost = $936,797,000; Non-Federal cost = $51,209,000 (see Table 9).

DEPARTMENT OF THE ARMY
VICKSBURG DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60
VICKSBURG, MISSISSIPPI 39180

REPLY TO
ATTENTION OF:

LMKPD-S

30 OCT 1981

SUBJECT: Atchafalaya

Commander, New Orleans District
ATTN: LMNPD-C

1. Reference letter LMNPD-C, 7 Oct 81, subject as above.

2. The inclosed data is furnished for input into subject study. It should be noted that the data is applicable to the Red River Backwater Area only and is based on readily available information.

3. Questions concerning the methodologies, assumptions, and/or results should be directed to Mr. Samuel P. Christian, FTS 542-5421.

1 Incl
as

SAMUEL P. COLLINS, JR.
Colonel, Corps of Engineers
Commanding

ATTACHMENT 1

ATCHAFALAYA BASIN STUDY
RED RIVER BACKWATER AREA

ALTERNATIVES STUDIED

1. The Vicksburg District has developed data concerning only the proposed modification of flows through the Old River Control Structure during the months of May, June, and July. Flows would be adjusted from the authorized 70/30 split in an attempt to keep stages at Acme, Louisiana, from exceeding 45 feet, National Geodetic Vertical Datum (NGVD), during those months previously mentioned; however, variations must be accomplished within the overall constraints of maintaining the 70/30 percent distribution on an annual basis.

HYDRAULIC CONSIDERATIONS

2. An analysis was conducted of the newly proposed Old River Control Structure operation plan to define the frequency and duration of flooding of major gaging locations in the Red River Backwater Area. The newly proposed plan involves the ORCS being operated to maintain a 70/30 distribution for the months of January through April, and August through December. For the months of May, June, and July the ORCS will be operated to maintain the Acme stage at or below 45 feet, NGVD, as long as the 18.3 feet of head differential is not exceeded on the ORCS and the structure operation does not force another floodway to be operated (i.e., Morganza or Bonnet Carre').

3. The analysis concluded that the base condition frequency curve for all gages other than Acme, Louisiana, and Jonesville, Louisiana, appropriately reflected this new alternative. The hydrographs for the original 45-foot alternative are appropriate for the new plan for the May, June, and July time period.

ECONOMIC CONSIDERATIONS

4. Table 1 provides a summary of benefits obtainable by modification of the 70/30 flow distribution through Old River Control Structure during the months of May, June, and July. The methodologies utilized were identical to those used in the evaluation of the previous alternatives involving modification of flow distributions. Price levels are 1981, and the interest rate used was 7-5/8 percent.

5. Implementation of the 70/30 modified alternative results in reduced annual flooding of cleared lands from 98,300 acres under the present operation to 95,000 acres with the modified alternative. This reduction translates into an average annual benefit of $1,409,000 in the Red River Backwater Area.

6. A copy of our previous submission is inclosed (Attachment 3) for your convenience.

TABLE 1
ATCHAFALAYA BASIN STUDY AVERAGE ANNUAL BENEFITS
BY AREA AND BENEFIT CATEGORY
ALTERNATIVE 70/30 MODIFIED

Area	Benefits by Category						Total Average Annual Benefits	Percent of Total
	Flood Damages Prevented				Intensification			
	Agricultural Crops	Agricultural Noncrop	Road and Bridge	Structures	Increased Net Returns	Land Clearing		
Sicily Island (Plan 6)	28,700	1,600	6,900	0	37,800	27,800	102,800	7.3
Below Larto Lake	4,000	100	800	0	29,700	0	34,600	2.4
Below Red River (Unprotected)	125,700	8,000	10,100	0	293,000	9,800	446,600	32.7
Below Red River (Levee B)	18,700	1,000	2,100	0	67,600	0	89,400	6.3
Bushley Bayou (Plan 7)	47,800	3,300	3,800	0	64,200	0	119,100	8.4
Bushley Bayou (Excluding Plan 7)	2,700	600	700	0	3,000	0	7,000	.5
Boeuf River (Reach 5)	27,200	0	0	0	51,100	0	78,300	5.6
Tensas River (Reach 3)	0	0	0	0	0	0	0	0.0
Tensas River (Reach 4)	22,600	0	0	0	154,600	0	177,200	12.6
Ouachita River (Reach 7)	3,800	0	0	0	15,000	0	18,800	1.3
Upper No Reach	8,400	0	0	0	99,300	0	107,700	7.6
Lower No Reach	47,300	2,500	2,600	0	175,500	0	227,900	15.3
Total	336,900	17,100	27,000	0	990,800	37,600	1,409,400	
Percent of Total	23.9	1.2	1.9	0.0	70.3	2.7	100.0	100.0

AFFECTED ENVIRONMENT

ENVIRONMENTAL CONDITIONS

7. The Red River Backwater Area, located in east-central Louisiana, extends from the Mississippi River westward for approximately 40 miles to the hill line west of the Black River and west of Catahoula Lake along Little River, and from the head of the Atchafalaya Basin north for approximately 100 miles to the latitude of Monroe, Louisiana, encompassing approximately 856,000 acres. Located in the Southern Mississippi Alluvium, this flat lowland area is characterized by flood plains and meander belts and intricate systems of interlacing streams, sloughs, lakes, and swamps. The backwater area is protected from direct overbank flooding of the Arkansas and Mississippi Rivers by the Arkansas and Mississippi Rivers levees from the latitude of Pine Bluff, Arkansas, to the Old River Closure and Control Structure. It is subjected to Mississippi backwater flooding and both overflow and backwater flooding from the Red and Black Rivers; however, flooding has been reduced in extent and duration throughout those areas of the basin where flood control works have been completed.

8. The area's fertile alluvial soil base, mild climate, abundant rainfall, and flat terrain are conducive to high agricultural productivity. Land clearing and draining for agricultural purposes have severely reduced the vast tracts of bottom-land hardwoods and wetlands that once occurred in this area. With the exception of Federal and state-owned wildlife refuges and management

areas, only small remnants of the once vast tracts currently remain. Major vegetative types are described as forested and nonforested. The nonforested category consists of cropland and pasture. The forested category is composed of major timber types which consist of bottom-land hardwoods, bald cypress-tupelo gum and cottonwood-willow-sycamore. The area has large areas of wetlands and open water. The two leading parishes in lake surface acreages are LaSalle (16 water bodies with 17,383 surface acres) and Avoyelles (50 water bodies with 10,270 surface acres). Catahoula and Concordia Parishes have the largest number of water bodies with 80 and 74, respectively. The largest lake within the area is Catahoula Lake which ranges from 5,000 to 25,000 acres. Overall water quality trends within the backwater area (bottom-land parishes) show a decline over the years and are attributable primarily to increased agricultural activity in the basin. Water quality in most of the small lakes in the bottom-land area has already declined to very poor and to only moderate in the remainder. Parameters indicating a decline in water quality are: increases in turbidity, suspended solids, plant nutrients (ammonia, nitrate, phosphate, etc.); pesticide residues; and decreases in dissolved oxygen.

SOCIAL, CULTURAL, AND ECONOMIC CONDITIONS

9. Thorough discussions of the social, cultural (see Attachment 1), and economic conditions are presented in other portions of this report and will not be reiterated in this section.

SIGNIFICANT RESOURCES

Open Water and Wetlands

10. As previously stated, the backwater area is rich in open water areas and wetlands. The largest, Catahoula Lake, is known for its nationally important wildlife habitat (waterfowl habitat, in particular). It is a major wintering area for waterfowl in the Mississippi Flyway. Due to its extreme seasonal water fluctuations, other water-based recreation and fishing are somewhat limited. Fish populations and standing crop values in all the lakes are directly correlated to water quality. Important wetland data for the Red River Backwater Area was developed in the 1975 inventory of the Ouachita River Basin using the criteria set forth in U. S. Fish and Wildlife's Circular 39. In this inventory, wetland types, their general location, and acreages within the basin were determined. This type of information is important to wildlife biologists, agricultural planners, and other individuals interested in land use changes and/or wetland preservation. It is also important that the many values of wetland areas be understood. Some of the basic major functions and values of wetlands are: (1) provide fish and wildlife habitat; (2) increase recharge of ground water; (3) retain surface water; (4) stabilize surface runoff; (5) reduce or prevent erosion; (6) produce timber; (7) create firebreaks; (8) provide outdoor laboratories for students, scientists, and photographers; and (9) provide for production of cash crops, such as crawfish, furs, and bait. Wetlands are used extensively for all waterfowl species

inhabiting the basin. In addition, 20 to 22 of Louisiana's 23 species of fur and game animals utilize wooded wetland types 1, 6, and 7 as all or part of their essential habitat.

11. In the Louisiana portion of the Ouachita Basin, wetland types 1 and 7 made up the majority of the wetland acreages, comprising 58 and 16 percent, respectively. Avoyelles, LaSalle, and Concordia Parishes contained the most wetland acres with 17, 17, and 13 percent, respectively, of the total Louisiana wetland areas studied. Parishes ranking first in wetland acreages for types 1 through 7 for the Louisiana portion of the basin study were type 1, Avoyelles; type 2, Ouachita; type 3, Tensas; type 4, Ouachita; type 5, Catahoula; type 6, LaSalle; and type 7, Avoyelles. The single most valuable wetland complex in the Louisiana portion of the basin study was Catahoula Lake and surrounding areas which totaled about 25,000 acres of wetland types 1 through 7.

Fishery Resources

12. Although the backwater area is experiencing declining water quality, its aquatic resources continue to be important natural assets. The complex systems of lakes, sloughs, bayous, streams, river channels, and associated wetlands result in highly diverse freshwater environments. These areas provide suitable spawning, nursery, feeding and escape habitat to a wide variety of aquatic organisms. These organisms are important components of the food web. In addition to their natural functions, some species are also important from a recreational and commercial standpoint. Fisheries standing

crop data for lakes with the backwater parishes are presented in Table 2. The standing crop data presented do not include crawfish data. Crawfish are of recreational and commercial importance during the spring high water season usually ending during May and June. In the natural environment, crawfish are a component in the diets of both terrestrial and aquatic predators.

Annually Flooded Forest Lands

13. Flood plain forests are among the highest in primary productivity of any ecosystem in the southeast (Brown et al., 1978). Conner and Day (1976) reported that litterfall in bottomland and cypress-tupelo stands in Louisiana exceeded most values reported for warm temperate upland forests. These are the flood plain's primary producers and the source of much of the detritus on the flood plain and in the rivers. Food chains on the flood plain floor are detritus-based. This detrital organic matter supplied to invertebrate life forms the basis for food chains that feed fish, birds, and mammals. Holder (1971) found flood plain productivity to be 15 to 20 times that of the river channel (crayfish at densities of 19 per 100 square meters formed one-third of the flood plain animal biomass).

14. The annually flooded forests of the backwater area and their associated wildlife species are adapted to and thrive under these conditions. Overstory species include overcup oak, Nuttall oak, honey locust, hackberry, bitter

TABLE 2
LAKE FISHERIES STANDING CROP DATA FOR PARISHES WITHIN
RED RIVER BACKWATER AREA

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Avoyelles		
12-2[a/]		
Bay Ronde	5	150
Big Bend	5	150
Blue Hale Lake	35	175
Cross Lake (complex)	165	200
Dry Cypress Lake	10	100
Duck Lake	130	125
Grand Lake No. 1	245	210
Grand Lake No. 2	30	200
Grassey Lake	80	200
Jimmy Lake	40	150
Lac Amelia	75	175
Lake Calebasse	30	150
Lake Didier	75	180
Lake Madam Lee	15	150
Lake Marna	10	150
Lake Poisson Arme	25	175
Lake Volais (complex)		35
Long Lake No. 1	45	190
Long Lake No. 2	25	190
Long Lake No. 3	10	180
Marais a Roche	60	200
Martin Bay	70	210
Morel Lake	65	205
Mouillier a'Yor	15	180
Muscle Lake	15	180
Nichols Lake	80	200
Petitie Bay	20	150
Red River Bay	85	210
Shark Bay	10	180
Smith Bay (complex)	315	220
Westcut Lake	95	210
12-3		
Bayou du Lac	1,235	110
Lake Ambrose	20	110
Lake Beceros	10	120
Avoyelles (cont)		
12-3 (cont)		
Lake Bois Sec	25	140
Lake Claire	50	180
Lake Ophelia	300	210
Lake Perlon du Chat	150	200
Lake St. Agnes	320	240
Lake Sollier	40	180
Little Lake Sollier	5	110
Old River	500	200
Petitie Lac du Grande Prelon	40	
Spring Bayou (complex)		5,290
12-4		
Johnson Lake	80	180
12-10		
Cannon Lake	10	110
Gin Lake	70	140
Grimes Lakes	10	110
Reynolds	140	180
Schamplnol Lake	55	140
Total	10,270	
Caldwell		
12al-4		
Brandon Lake	22	110
Brushy Lake	205	200
Eagle Lake	30	180
Ferrand Lake	50	110
Horseshoe Lake No. 1	80	120
Horseshoe Lake No. 2	110	130

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Caldwell (cont)		
12a1-4 (cont)		
Humble Lake	70	110
Reiverton Lake	20	120
Swim Lake	40	150
Volman Lake	90	170
Wheeler	20	180
12a1(e)-1		
Bayou LaFourche	1,000	140
Crew Lake	40	180
Davis Lake	185	200
Hinze Lake	20	140
Locust Thicket Lake	25	130
Long Lake	205	190
Old Channel	60	170
Sawyer Pond	65	160
Wild Boar Lake	10	140
12a1(e)-2B		
Long Lake	10	110
Morenyo Lake	95	150
Open Lake	8	110
Short Lake	5	110
Total	2,465	
Catahoula		
12-5		
Big Hole	8	120
Mitten Lake	10	110
Swan Lake	35	140
12-6		
Burr Lake	8	110
California Bayou	22	120
Eagle Nest Lake	18	130
Five Point Lake	18	130
Hibbs Lake	20	120
Maknockanut Lake	55	180
Open Brake	20	140
Parker Lake	20	140
Snaggy Lake	195	195
Willow Lake	140	190
Catahoula (cont)		
12-6 and 12-7		
Shad Lake	1,140	240
12-7		
Babays Lake	50	195
Birds Nest Lake	105	200
Devils Lake	18	180
Fish Lake	8	110
Fisher Lake	200	180
Larto Lake	2,100	250
Wash Lake		180
12-11		
Horseshoe Lake	10	140
Lorran Lake	33	150
Round Lake	55	160
Snaggy Lake	5	120
Whites Lake	35	110
Willow Lake	12	140
Wise Lake	45	150
12a1-1		
Bens Lake	50	160
Billys Bayou Lake	5	110
Black Bayou Lake	6	110
Brooks Lake	25	120
Buck Lake	5	110
Cash Lake	22	140
Coon Lake	8	110
Dead Lake	5	110
Ditto Lake	25	110
Fool River	260	190
George Lake	5	110
Green Lake	8	110
Guthrie Lake	80	120
Lake Louis	1,000	190
Little Bens Lake	10	110
Mean Lake	260	180
Ruffee Lake	40	170
Sheppards Lake	8	110
Well Lake	40	140
York Lake	18	120
12a1-2		
Dry Lake	12	110
Sargent Lake	80	180
Town Lake	30	110

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Catahoula (cont)		
12al-3		
Big Lake	70	150
Stafford Lake	35	140
12al(e)-1		
Barnett Lake	35	140
Brush Lake	33	130
Cypress Lake	20	105
Dailey Lake	22	145
Rock Lake	45	150
Sunk Lake	8	110
12al(f)-1		
Black Lake	8	105
Half Mile Lake	20	140
Hoover Lake	85	150
Knockunat Lake	25	135
Middle Lake	15	120
Pool Lake Bayou	40	135
River Lake	20	120
Sunflower Lake	10	110
Trap Lake	15	105
Twomile Lake	35	110
Willow Lake	6	105
12al(g)-1		
Black Lake No. 1	3	110
Black Lake No. 2	8	110
Dempsey Lake	38	140
Fish Lake	5	110
Long Lake	85	170
Rhinehart Lake	20	140
Round Lake	20	130
Sandy Lake	45	155
Tew Lake	185	230
Wallace Lake	245	230
Total	7,608	
Claiborne		
12al(d)-4		
Callender Pond	8	100
Clampit Lake	20	120
Claiborne (cont)		
12al(d)-5		
Goodwin Lake	36	125
J. R. King Lake	35	130
Lake Claiborne	6,400	150
Lake Herman	22	120
Moreland Lake	20	110
12al(d)(1)-1		
Corney Lake	1,900	110
Total	8,441	
Concordia		
12-1		
Flat Lake	75	140
Goose Lake	5	130
Grand Bay	208	210
Hog Pen Lake	38	240
Lost Lake	7	180
Lower Sunk Lake	770	210
Moreau Lake	25	200
12-11		
Big Lake	25	190
Donnelly Lake	62	185
Royster Lake	5	140
12al-1		
Chaney Lakes (3)	54	180
Jerry Lake	20	170
Lake Curry	20	170
Patton Lake	64	190
School House Lake	8	170
Upper Sunk Lake	45	210
Welsh Lake	85	200
Whiskey Bayou Lakes (3)		40
Williams Lake	65	195
12al-2		
Bee Lake	40	180
Big Lagoon	20	170
Black Lake No. 1	26	195
Black Lake No. 2	335	205
Blue Lake No. 1	20	195
Blue Lake No. 2	12	190

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Concordia (cont)		
12a1-2 (cont)		
Brickyard Lake	40	195
Brushy Bayou	311	210
Carr Lake	9	170
Cauley Lake	60	160
Clayton Lake	22	150
Clear Lake	5	140
Cocodrie Lake	1,112	240
Concordia Lake	1,000	210
Crowder Lake	12	190
Crouch Lake	5	140
Cypress Lake No. 1	10	170
Cypress Lake No. 2	12	180
DeArmond Lake	21	180
Dobbins Lake	5	170
Dry Lake	14	110
Duck Roost Lake	2	100
Emiline Lake	25	180
Flat Lake	6	110
French Lake	50	190
Gin Lake No. 1	10	170
Gin Lake No. 2	12	170
Grandma Lake	10	160
Jenkins Lake	22	150
Lake St. John	2,100	210
Little Gin Lake	8	180
Little Lagoon	16	170
Little Wallace Lake	12	170
Lower Clear Lake	6	140
Mack Lake	40	170
Myers Lake	12	160
Ox Lake	50	180
Pandora Lake	12	140
Parish Lake	12	140
12a1-2		
Round Lake No. 1	95	200
Round Lake No. 2	20	195
Round Lake No. 3	10	190
Shanty Lake	45	180
Shavings Lake	8	140
Snag Lake	10	140
Tronsel Lake	8	130
Turtle Lake	110	170
Twin Lake	40	140
Upper Clear Lake	6	110
Wade Lake	32	180
Wallace Lake	10	120
Whitehall Lake	45	135
Total	7,629	
Franklin		
12a1(e)-2E		
Don Lake	5	125
Dry Lake	12	200
Fool River Lake	18	250
Forest Lake	48	225
Goose Lake	38	225
Guice Lake	15	200
Hicktom Lake	10	200
Horseshoe Lake	25	225
Mullen Lake	6	150
Plum Thicket Lake	18	175
Sims Lake	25	180
Turkey Creek Lake	3,000	
Willis Lake	14	170
12a1(f)-3		
Batese Lake	3	150
Beaver Lake	25	225
Beeler Lake	20	225
Big Cow Lake	19	200
Board Tree Lake	5	175
Calf Lake	3	175
East Johnson Lake	3	175
East Lake	15	225
Green Lake	21	230
Hog Lake	15	200
Johnson Lake	3	150
Little Cow Lake	15	200
Lake Dean	90	225
Little Lake	2	175
Middle Lake	6	200
Moon Lake No. 1	3	175
Moon Lake No. 2	8	175
Twin Lakes	16	225
12a1(f)-4		
Little Lake	15	280
Trusler Lake	8	230

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Franklin (cont)		
12al(f)-1		
Bayou Macon Cutoff No. 1		238
Bayou Macon Cutoff No. 2		140
Bayou Macon Cutoff No. 3		138
Harris Lake	27	225
Hollywod Lake	40	250
Redfield Lake	5	175
Total	4,117	
La Salle		
12-7 and 12-8		
Saline Lake	1,810	200
12al(g)-2		
Horseshoe Lake	25	200
Hub Lake	14	180
Kitterlin Bay	160	210
Walker Lake	88	200
Lehman Lake	20	200
Round Lake	12	170
Search Lake	20	160
Trout Mill Ponds	95	130
Woodward Lake	7	140
12al(g)-2A		
Catahoula Lake	5,000-25,000	
Little Lake	35	140
Little Lake Slough	10	130
Willow Lake	50	180
12al(g)(1)(a)-1		
Hunts Pond	12	170
12al(g)(1)(a)-2		
Uranla Mill Pond	25	170
Total	17,383	
Ouachita [b]		
Cheniere Brake	3,115	120 [c]
Cotton Patch Lake	15	190
Country Club Lake	65	160
D'Arbonne Hills Lake	35	320
Hamilton Lake	55	320
Ouachita (cont)		
Horseshoe Lake	40	285
Lake Lafitta	100	410
Little Lake	8	160
McGuire Lake No. 1	6	160
McGuire Lake No. 2	12	160
Mills Pond	20	160
Moon Lake	60	325
Pace Lake	80	380
Phillips Lake	65	240 [c]
Pucketts Lake	5	160
Rushing Lake	55	275
Walls Lake Basin	50	310
Walls Lake	30	345
Whites Lake	40	320
12al(e)-8		
Black Bayou Lake	2,000	120 [c]
Bayou DeSiard (north)		608
Bayou DeSiard (south)		607
Kings Lake	80	420
Ramson Lake	50	360
Water Lake	14	140
Total	7,215	
Rapides		
12-10		
Bayou Maria Basin	360	140
Beaver Lake	125	130
Big Lake	30	120
Buttonwood Lake	200	110
Hog Lake	500	120
Lockhart Lake	30	110
Mill Pond	30	120
Pierson	28	130
Spring Bayou	260	160
Tanyard Lake	100	140
Tarkill Lake	70	130
Williams Lake	500	180
Camp Beauregard Lake	23	150
Total	2,256	

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Richland [b]		
12al(e)-4A		
Cutoff Bayou	20	90
Hammett Lake	12	160
Hewitt Lake	30	130
Jonesburg Lake	75	80
Jordan Lake	50	120
McElroy Lake	30	110
Saryre Lake	14	140
Tank Lake	5	90
Thompson Lake	30	60
Wollen Lake	240	160
12al(e)-10C		
Clear Lake	160	170 [c]
Crew Lake	70	60
Dead Lake	10	130
Little Lake LaFourche		165
Total	910	
Tensas		
12al(f)-2		
Allen Lake	10	150
Bell Lake	5	140
Big Hog Glade	28	160
Big Lake	70	190
Black Lake	38	195
Boggy Lake	45	180
Bowman Lake	5	150
Broad Lake	35	170
Brushy Lake No. 1	25	180
Brushy Lake No. 2	22	180
Bryland Lake	75	195
Cindy Lake	8	140
Duck Lake	22	160
Fish Lake	5	140
Fletchers Lake	440	200
Fox Lake	60	180
Gin Lake No. 1	8	160
Gin Lake No. 2	15	170
Hunter Lake	5	160
Jackson Lake	18	150
Lackmen Lake	18	150
Lake Black Dog	8	160
Lake Formosa	65	170
Lake Misery	12	170
Tensas (cont)		
Levi Lake	35	170
Little Fletchers	75	195
Mackey Lake	8	150
May Lake	20	160
Mile Lake	8	140
Miller Lake	20	150
Mossy Lake	18	160
Reed Lake	25	170
Saddletree Lake	38	185
Shelley Lake	5	140
Snotgrass Lake	10	150
Turkey Lake	8	160
Wilson Lake	12	165
12al(f)-4		
Alligator Slough	20	140
Big Lake	120	195
Big Pond	75	190
Brushy Lake	15	180
Duck Lake	155	200
Fool Lake	60	190
Grassy Lake	210	200
Hopaka Lake	45	190
Johnson Lake	85	185
Lake Bruin	3,000	220
Lake Marydale	135	200
Lake St. Joseph	1,300	220
Lake Shallow	30	190
Little Flag Lake	22	180
Little Johnson Lake	60	170
Lodge Lake	45	165
Long Lake	12	170
Mill Lake	390	195
Molen	8	180
Mud Lake No. 1	55	190
Mud Lake No. 2	485	195
Shackleford Lake	48	180
Sketter Lake	22	175
Turkey Lake	55	180
Watermelon Lake	12	170
Daniel Lake	15	175
Willow Lake	12	170
Lake Twentynine	30	180
Cow Lake	30	185
Brushy Lake No. 3	7	180
Brushy Lake No. 4	50	190

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)	Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Tensas (cont)					
Trosler Lake	8	160			
Little Lake	12	170			
Horse Lake	30	180			
Total	7,982				

Sources: Louisiana Department of Wildlife and Fisheries and Soil Conservation Service.

a/ Watershed number.

b/ Estimate of standing crop for these parishes provided by Louisiana Department of Wildlife and Fisheries.

c/ Actual population sample data.

pecan, willow oak, sweetgum, cypress, water elm, and water locust. Reliable studies have shown that such bottom-land species are benefited by seasonal flooding. Improved tree growth and mast production is, in turn, beneficial to wildlife species, such as deer, squirrel, and waterfowl, that depend to some extent on mast for food supply. The presence of water from seasonal flooding is essential to use of the area by waterfowl, wading birds, and certain furbearers, reptiles and amphibians. Seasonal flooding of the forest areas also makes a positive contribution to the aquatic resources of lakes and streams by providing extensive feeding, spawning, and nursery areas. The flooded forests and wetlands serve as storage areas for floodwaters and recharge areas for groundwater. The wetlands also play an important role in natural filtration, contributing to the maintenance of water quality. Seasonal flooding is necessary for the continued existence of the present bottom-land and wetland ecosystems.

Annually Flooded Openland

15. The annually flooded openland is used almost exclusively for soybean production, due in part to compatibility with frequent flooding. Seasonal flooding of the openlands provides a higher value habitat for game and nongame species when compared to dry openland values. The terrain of the area is a series of low ridges and swales; in many instances, ponded water is found in low areas. These isolated wet areas provide ideal habitat for waterfowl, wading birds, furbearers, and reptiles and amphibians. These isolated wet areas, by preventing intensive farming, allow the occurrence and growth of native grasses, herbs, and woody vegetation. This diversity of habitat is

highly beneficial to small game such as rabbits, quail, and dove and a variety of nongame birds and small mammals. Small mammals provide food sources for hawks, owls, and other predators. Flooding of the low areas, including native vegetation and soybean fields, provides food sources for waterfowl in season. Periodic flooding of openlands is important to maintaining the present habitat conditions for wildlife.

Wildlife Resources

16. Broadly classified wildlife habitat types (vegetative types) include bottomland hardwoods, pasture land, and cropland. Table 3 summarizes the Louisiana population and harvest data for selected game species (rabbit, squirrel, turkey, deer, quail, and dove). This information is presented by parish and habitat type. Population data including habitat acreages, animals per acre, and total animals and harvest data including number harvested and man-days of recreation are presented. The harvest data were calculated from a 3-year average of small game surveys conducted in 1967-1968, 1972-1973, and 1974-1975. Since this survey is broken down by parish and based on the number of hunting licenses sold by parish, the resulting harvest data do not reflect an accurate measure of harvests within each of the individual parishes. Rather, it reflects the estimated harvest by persons who bought licenses in that parish. Of equal importance are various other wildlife species including waterfowl, raptors, passerines, wading birds, furbearers, and amphibians.

TABLE 3

INVENTORY OF GAME SPECIES, POPULATION, AND HARVEST DATA, LOUISIANA[a/]

Species	Parish	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation
		UPLAND HARDWOOD					BOTTOM-LAND HARDWOOD				
Rabbit											
	Avoyelles	2,509	1-7	358	36	24	117,913	1-1	117,913	11,791	7,757
	Caldwell	56,052	1-7	8,007	801	527	98,091	1-1	98,091	9,809	6,453
	Catahoula	28,769	1-7	4,110	411	270	119,185	1-1	119,185	11,919	7,841
	Concordia			[b/]			213,830	1-1	213,830	21,383	14,068
	Franklin			[b/]			53,070	1-1	53,070	5,307	3,491
	LaSalle	35,423	1-7	5,062	506	333	122,009	1-1	122,009	12,201	8,027
	Ouachita	34,083	1-7	4,869	487	320	104,683	1-1	104,683	10,468	6,887
	Rapides	12,193	1-7	1,742	174	114	40,644	1-1	40,644	4,064	2,674
	Richland						87,020	1-1	87,020	8,702	5,725
	Tensas						137,680	1-1	137,680	13,768	9,058
Squirrel											
	Avoyelles	2,509	1-1.0	2,509	836	442	117,913	1-.75	15,722	5,241	2,773
	Caldwell	56,052	1-1.0	56,052	18,684	9,886	98,091	1-.75	130,788	43,596	23,067
	Catahoula	28,769	1-1.0	28,769	9,590	5,074	119,185	1-.75	158,913	52,971	52,969
	Concordia			[b/]			213,830	1-.75	285,107	95,036	50,284
	Franklin			[b/]			53,070	1-.75	70,760	23,587	12,480
	LaSalle	35,423	1-1.0	35,423	11,808	6,248	122,009	1-.75	162,679	54,226	28,691
	Ouachita	34,083	1-1.0	34,083	11,361	6,011	104,683	1-.75	139,577	46,526	24,617
	Rapides	12,193	1-1.0	12,193	4,064	2,150	40,644	1-.75	54,192	18,064	9,558
	Richland						87,020	1-.75	116,027	38,676	20,463
	Tensas						137,680	1-.75	183,573	61,191	32,376

TABLE 3 (cont)

Species	Parish	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation
Turkey											
	Avoyelles										
	Caldwell	56,052	1-500	122		No season	98,091	1-1,300	75		No season
	Catahoula	28,769	1-1,000	288		No season	119,185	0	0	0	0
	Concordia			b/			213,830	1-10,000	21		No season
	Franklin			b/			53,070	1-1,000	53	5	300
	LaSalle	35,423	1-2,000	18		No season	122,009	1-1,000	122		No season
	Ouachita	34,083	1-500	68	2	120	104,683	1-2,000	52	3	180
	Rapides			b/							
	Richland			b/			87,020	1-500	17		No season
	Tensas			b/			137,680	1-250	551	20	1,200
Deer											
	Avoyelles	2,509	1-25	100	12	275	117,913	1-20	5,896	545	12,481
	Caldwell	56,052	1-25	2,242	423	9,687	98,091	1-20	4,905	739	16,923
	Catahoula	28,769	1-25	1,151	93	2,130	119,185	1-20	5,959	386	8,839
	Concordia			b/			213,830	1-20	10,692	5,178	118,567
	Franklin			b/			53,070	1-20	2,654	311	7,122
	LaSalle	35,423	1-25	1,417	79	1,809	122,009	1-30	4,067	272	6,229
	Ouachita	34,083	1-25	1,363	162	3,710	104,683	1-25	4,187	496	11,358
	Rapides	12,193	1-25	489	15	344	40,644	1-25	1,626	49	1,122
	Richland						87,020	1-20	4,351	602	13,786
	Tensas						137,680	1-7	19,669	5,679	130,049

TABLE 3 (cont)

Species	Parish	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation
		PURE PINE					MIXED PINE - HARDWOOD				
Squirrel											
	Avoyelles	5,108	1-9	558	186	98					
	Caldwell	70,065	1-9	7,785	2,595	1,373	56,052	1-2.5	22,421	7,474	3,955
	Catahoula	14,384	1-9	1,598	533	282	43,152	1-2.5	17,261	5,754	3,044
	Concordia			b/							
	Franklin	5,825	1-9	647	216	114	5,825	1-2.5	2,330	777	411
	LaSalle	181,047	1-9	20,116	6,705	3,548	55,101	1-2.5	22,040	7,347	3,887
	Ouachita	70,601	1-9	7,845	2,615	1,384	34,083	1-2.5	13,633	4,544	2,404
	Rapides	58,256	1-9	6,473	2,158	1,142	24,387	1-2.5	9,755	3,252	1,721
	Richland			b/							
	Tensas			b/							
Quail											
	Avoyelles	5,018	1-3	1,673	167	77					
	Caldwell	126,117	1-3	42,039	4,204	1,937					
	Catahoula	57,536	1-3	19,179	1,918	884					
	Concordia			b/			NOT APPLICABLE				
	Franklin	11,650	1-3	3,883	338	179					
	LaSalle	236,148	1-3	78,716	7,872	3,628					
	Ouachita	104,684	1-3	34,895	3,490	1,608					
	Rapides	82,643	1-3	27,548	2,755	1,270					
	Richland										
	Tensas										

TABLE 3 (cont)

Species	Parish	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Man-days Number	Man-days Recreation	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Man-days Number	Man-days Recreation
		PASTURELAND					CROPLAND				
Dove											
	Avoyelles	18,600	1-.8	23,250	3,488	872	83,120	1-.8	103,900	15,585	3,896
	Caldwell	18,670	1-.8	23,338	3,501	875	36,920	1-.8	46,150	6,923	1,731
	Catahoula	8,880	1-.8	11,100	1,665	416	239,270	1-.8	299,088	44,863	11,216
	Concordia	49,230	1-.8	61,538	9,231	2,303	122,200	1-.8	152,750	22,913	5,728
	Franklin	59,000	1-.8	73,750	11,063	2,766	255,220	1-.8	319,025	47,854	11,964
	LaSalle	6,230	1-.8	7,788	1,168	292	5,450	1-.8	6,813	1,022	256
	Ouachita	25,170	1-.8	31,463	4,719	1,180	64,240	1-.8	80,300	12,045	3,011
	Rapides	5,400	1-.8	6,750	1,013	253	1,680	1-.8	2,100	315	79
	Richland	73,970	1-.8	92,463	13,869	3,467	192,370	1-.8	240,463	36,069	9,017
	Tensas	75,550	1-.8	94,438	14,166	3,542	114,790	1-.8	143,488	21,523	5,381
Quail											
	Avoyelles	18,600	1-3	6,200	620	286	83,120	1-3	27,707	2,771	1,277
	Caldwell	18,670	1-3	6,223	622	287	36,920	1-3	12,307	1,231	567
	Catahoula	8,800	1-3	2,933	293	135	239,270	1-3	79,757	7,976	3,676
	Concordia	49,230	1-3	16,410	1,641	756	122,200	1-3	40,733	4,073	1,877
	Franklin	59,000	1-3	19,667	1,967	906	255,220	1-3	85,073	8,507	3,920
	LaSalle	6,230	1-3	2,077	208	96	5,450	1-3	1,817	182	84
	Ouachita	25,170	1-3	8,390	839	387	64,240	1-3	21,413	2,141	987
	Rapides	5,400	1-3	1,800	180	83	1,680	1-3	560	56	26
	Richland	73,970	1-3	24,657	2,466	1,136	192,370	1-3	64,123	6,412	2,955
	Tensas	75,550	1-3	25,183	2,518	1,160	114,790	1-3	38,263	3,826	1,763

TABLE 3 (cont)

Species	Parish	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation	Population Data: Habitat Acres	Animals Per Acre	Total Animals	Harvest Data: Number	Man-days Recreation
Rabbit											
	Avoyelles	18,600	1-1	18,600	1,860	1,224	83,120	1-15	5,541	554	364
	Caldwell	18,670	1-1	18,670	1,867	1,228	36,920	1-15	2,461	246	162
	Catahoula	8,800	1-1	8,800	880	579	239,270	1-15	15,951	1,595	1,049
	Concordia	49,230	1-1	49,230	4,923	3,239	122,200	1-15	81,347	8,135	5,352
	Franklin	59,000	1-1	59,000	5,900	3,882	255,220	1-15	17,015	1,702	1,120
	LaSalle	6,230	1-1	6,230	623	410	5,450	1-15	363	36	24
	Ouachita	25,170	1-1	25,170	2,517	1,656	64,240	1-15	4,283	428	282
	Rapides	5,400	1-1	5,400	540	355	1,680	1-15	112	11	7
	Richland	73,970	1-1	73,970	7,397	4,866	192,370	1-15	12,825	1,283	844
	Tensas	75,550	1-1	75,550	7,555	4,970	114,790	1-15	7,653	765	503

a/ Source: Louisiana Department of Wildlife and Fisheries and Soil Conservation Service.
b/ Data unavailable.

17. As previously mentioned, the Catahoula Lake complex is extremely important for waterfowl in the Mississippi Flyway. It plays an important role in the abundance and distribution of waterfowl. The Louisiana Department of Wildlife and Fisheries' biologists estimated that this one lake had a yearly average of 20,369,000 "duck days" for the 10-year period 1960-1970. It is estimated that 80,000 ducks were harvested on Catahoula Lake during the 1970-71 hunting season.

18. Attachment 2 presents data that were developed for the Sicily Island and the Below Red River areas (parts of the Red River Backwater Area) and will be used for actual evaluation purposes in the Environmental Effects section.

Endangered Species

19. A study of the endangered species in the Below Red River Area was conducted by Louisiana State University in May 1977 for the Vicksburg District to determine the present status of seven endangered animal species which could possibly occur in the area. The study concluded that the American alligator was the only endangered species (now classified as threatened in Louisiana) that occurred in the area. The bald eagle and peregrine falcon may occasionally occur in migration. There is no possibility that the red wolf and ivory-billed woodpecker survive in the area and little, if any, possibility of the Bachman's warbler being present. Little habitat for the Florida panther remains in the project study area and no evidence of occurrence was found during the study. In studies conducted for Bushley Bayou, Sicily Island, and the Tensas River, similar conclusions were drawn.

Federal Wildlife Refuges and State Wildlife Management Areas

20. Within the Red River Backwater study area, there are six wildlife management areas, one state waterfowl refuge, and one national wildlife refuge. Table 4 gives the location, size, and administrative agency of these areas as of June 1979.

TABLE 4
INVENTORY OF FEDERAL REFUGES AND STATE WILDLIFE MANAGEMENT AREAS
JUNE 1979

Wildlife Area or Refuge	Parish	Size (acre)	Administrative Agency[a/]
Wildlife Management Areas			
Grassy Lake	Avoyelles	11,860	LDWF
Pomme DeTerre	Avoyelles	3,991	LDWF
Red River	Concordia	16,604	LDWF
Saline	LaSalle and Concordia	60,275	LDWF
Spring Bayou	Avoyelles	11,677	LDWF
Three Rivers	Concordia	23,231	LDWF
State Waterfowl Refuge			
Catahoula	LaSalle	1,010	LDWF
National Wildlife Refuge			
Catahoula	LaSalle	5,308	FWS

a/ LDWF - Louisiana Department of Wildlife and Fisheries
FWS - U. S. Fish and Wildlife Service

Unique, Natural and Scenic Streams

21. Under Louisiana's Natural and Scenic Rivers System Act (R.S. 56: 1841-1849), a number of streams and stream segments have been identified as natural and scenic rivers. Four of these are located in or near the Red River Backwater Area. These include:

a. Little River from the juncture of Dugdemona and Castor Creeks to its entrance into Catahoula Lake.

b. Trout Creek from its origin near Highway 8 to its entrance into Little River.

c. Saline Bayou from Saline Lake to Larto Lake.

d. Bayou Cocodrie from Wild Cow Bayou to Little Cross Bayou in Concordia Parish.

Prime or Unique Farmland

22. Due to the frequency of flooding in the directly affected portion of the Red River Backwater Area, most areas would not meet the criteria of the U. S. Department of Agriculture which state: The soils are not flooded frequently during the growing season (less often than once in 2 years) and will not be addressed in this evaluation.

Cultural or Historical Resources

23. A number of cultural studies have been conducted under Corps contract within the general area. A summary of these studies and a comprehensive bibliography are contained in Attachment 1 and will not be reiterated in this section of the report.

ENVIRONMENTAL EFFECTS

GENERAL

24. Even minor modifications of hydrologic regime within a dynamic river system can result in direct and cumulative environmental effects in the immediate area and both upstream and downstream. Hydrologic and economic data developed in the course of this study indicated that modification of the existing 70/30 split (used as a base condition) during the months May, June, and July will directly affect approximately 3,000 acres of cleared land and 8,600 acres of woodland within the backwater area on an average annual basis. Land use projections indicate that in anticipation of possible modification, 601 and 369 acres of bottom-land hardwoods would be cleared in the Sicily Island and the Below Red River areas, respectively. Man-day values per acre for various wildlife forms by habitat type are presented in Table 5. These data are averages of data developed in the Sicily Island and Below Red River areas presented in Attachment 2. In addition to the quantifiable impacts, this environmental evaluation will briefly address qualitatively the geo-hydro-biological interrelationships of the area's rivers and their flood plains. The entire length of a river system should be considered in evaluating the function of any part. Hydrological phenomena are extremely important within the systems. The ecosystems of

the backwater area, as with most alluvial systems, are adapted and dependent upon fluctuating water levels. The importance of the wooded flood plain and wetland areas to water quality will not be reiterated in detail. A number of documented studies have shown the importance of the contact time between water and organic debris and the removal of various pollutants.

TABLE 5
MAN-DAY VALUE PER ACRE [a/]
BY HABITAT TYPE

Habitat Type	Bottom-Land Hardwood	Openland
Large game	0.368	0.0
Small game	0.45	0.128
Waterfowl	0.109	0.019
Wildlife-oriented recreation	0.81	0.13
Fur Harvest	(0.17)	(0.044)
Total Man-Day Value Per Acre	1.737	0.277

a/ Average of data presented in Attachment 2.

OPEN WATER AND WETLANDS

25. Decreasing the diversion of water from the Mississippi River during the late spring and early summer months would result in detrimental effects to open water and associated wetland areas unless there would be a corresponding increase of flows during critical low-water periods. Stabilized water levels

during the planting season would induce further land clearing and diminish the mineral rejuvenation realized from backwater sedimentation. Encroachment by agriculture will increase the sediment and the associated agriculture pollutant levels in the remaining open water and wetlands that are currently experiencing some environmental stress. Increased sediment loads in lakes will, in time, increase lake bottom elevations, decreasing water depths which in turn will decrease the area's permanent water bodies. Succession of wetlands to drier habitat types could be accelerated.

FISHERY RESOURCES

26. Decreased water depths in open water areas would reduce the intra-habitat diversity within those areas. Loss of any open water area that provides the only available habitat for aquatic species during the critical summer and fall low-water periods would result in declines in density, standing crop, and year class strength of numerous aquatic species. Drying of wetland areas during late spring and early summer would reduce the amount of essential spawning, feeding, and nursery areas which in turn would increase competition for mutual life requisites.

ANNUALLY FLOODED FORESTS

27. The trophic system of annually flooded forests is dependent upon the annual sequence of high- and low-water periods. Altering of the system would directly affect biological productivity. Decreases in the amount of available detritus on the forest floor would affect the related food chains of various

aquatic and terrestrial species within the immediate area and downstream. Quantifying these types of environmental effects is difficult and requires time and effort for a detailed study. However, some effects can be quantified. Hydrologic and economic studies can project induced clearing rates in anticipation of reduced flooding within the area. In addition to the Vicksburg District studies that have been conducted, other studies have shown that there is a direct correlation between reduced flooding during the planting season and the rate of clearing bottom-land hardwoods in the Alluvial Valley. It appears that forested areas adjacent to agricultural land, if dewatered during the planting season, are generally the areas to be affected. Our immediate studies have shown that there will be induced clearing in anticipation of reduced flooding and stabilized flooding stages within the backwater area. Our study has shown that 970 acres of forested land would be cleared and converted to agricultural uses within the Red River Backwater Area.

ANNUALLY FLOODED OPENLAND

28. Modification of flows in May, June, and July during the planting season would reduce flooding on 2,862 acres of cleared land. In anticipation of stabilized flood stages, 970 acres of forested area would be cleared and converted to agricultural land. Reduced flooding would be beneficial from an agricultural and economic standpoint. However, it would result in adverse impacts on the environmental resources.

WILDLIFE RESOURCES

29. Wildlife resources in the Red River Backwater Area would be both benefitted and adversely affected if flows are modified during May, June, and July. Loss of bottom-land hardwood habitat when compared to an increase of openland habitat would result in a direct net loss of 1,416 man-days of wildlife-oriented use. Benefits of 269 man-days associated with an increase in openland habitat are greatly overshadowed by the direct loss of 1,685 man-days which are associated with a decrease in bottom-land hardwood habitat, resulting from the induced clearing of 970 acres of such habitat.

ENDANGERED SPECIES

30. No longer classified as endangered but still classified as threatened, the American alligator is a permanent resident in the backwater area. No endangered species are permanent residents of the backwater area, so there should be no adverse effects to any species classified as endangered.

FEDERAL WILDLIFE REFUGES AND STATE WILDLIFE MANAGEMENT AREAS

31. The refuges and management areas are protected by law from induced land use changes but could experience some increased pressure and stress problems if privately owned lands, both wooded and wetlands, surrounding these protected areas are cleared or modified.

SCENIC STREAMS

32. Modification of flows through the Old River Control would not appreciably impact the scenic streams within the Red River Backwater Area.

CULTURAL RESOURCES

33. Effects on cultural resources of the Red River Backwater Area are discussed in Attachment 2.

CONCLUSIONS

34. Based on stage-frequency data for the years of 1949-1974, stages at the Acme gage do not exceed 45 feet, NGVD, every year during the months of May, June, and July. Even considering that this is not an annual event, economic studies have shown that induced clearing would take place in anticipation of stabilized flood elevations.

35. Within recent years the land clearing trend in the backwater area has accelerated and it appears that the trend is following that of the north Louisiana parishes. This trend strongly indicates that the future for privately owned forested wetlands in the Red River Backwater Area does not appear to be good, unless acquisition for preservation increases or applicable regulatory programs are effective. Any further inducement will only

accelerate the trend, and this study has shown that modification of flows through the Old River Control Structure during the planting season would further induce the clearing of an additional 970 acres.

36. If the authorized 70/30 annual distribution is to be maintained and flows are decreased during every spring and summer, then flows must be increased at some point during the year. If this is feasible (i.e., water is available), adverse impacts could possibly be offset by benefiting fish and wildlife resources during critical low water stress periods. However, if corresponding increases are not feasible, the authorized 70/30 distribution would not be maintained, resulting in a net adverse impact to fish and wildlife resources in the backwater area and further downstream. However, the losses associated with induced land clearing cannot be compensated without appropriate mitigation measures.

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ATTACHMENT 1
POSSIBLE IMPACTS ON
CULTURAL RESOURCES WITH MODIFIED OPERATION OF THE
OLD RIVER CONTROL STRUCTURE

1. Inclosure 1 is an annotated bibliography of cultural resources investigations conducted in the Red River Backwater Area by the Vicksburg District. Should the modified plan (holding stages at Acme, Louisiana, at elevation 45.0 feet, NGVD, when possible during the months of May, June and July) be implemented, comprehensive reconnaissance and intensive on-ground surveys will be necessary for those lands which will be affected by Corps activities.

2. If the modified plan is implemented and additional agricultural lands are made available through land clearing, any existing cultural resources on these lands could be adversely impacted. Increased land clearing and leveling operations, as well as plowing activities, may destroy or at least have a negative effect on archeological/historic sites. Exposure of any sites through these activities may lead to vandalism as a result of their visibility. In addition, other construction activities made possible because of lowered water levels (such as ditching and leveeing) could adversely affect cultural resources.

3. Although the effects of intermittent inundation on cultural resources or newly cleared lands have not been intensively studied, impacts may include:

a. Chemical alteration of soil, shell, bone, and charcoal causing incorrect interpretations of these remains.

b. Wave action, saturation, and erosion causing sites to lose all associative contextural properties and thus lose their value as resources for scientific investigation.

c. Physical loss of sites through erosion.

CULTURAL RESOURCES INVESTIGATIONS
OF RED RIVER BACKWATER AREA PERFORMED FOR VXD

Brazda, Steven J.
1976 Archeological Survey of the 1975 Catahoula Lake Diversion Channel Dredging Project, LaSalle Parish, Louisiana

Comment: No archeological sites observed or recovered during the dredging activities on the diversion channel.

Coastal Environments, Inc.
1981 A Cultural Resources Survey of the Tensas-Cocodrie Levee Enlargement, Item 2, Concordia Parish, Louisiana

Comment: 15 sites noted in survey (1 prehistoric occupation, 12 historic sites, 2 prehistoric/historic sites.

Gibson, Jon
1981 (In preparation) Cultural Resources Survey of the Sicily Island Area Levee Project, Item 1

Comment: Seven archeological sites located in rights-of-way; one site of National Register significance.

Gregory, H. F. and H. K. Curry
1976 Archeological Reconnaissance, Lower Bushley Bayou Project

Comment: Three sites located in project area but none was significant. Reconnaissance included on-the-ground survey, records check, and literature search.

Gulf South Research Institute
1974 History and Archeology of the Red River Backwater General/Sicily Island/Bushley Bayou Area, Louisiana

Comments: The report was found to be acceptable as a general archeological reconnaissance, but lacked sufficient information for evaluation of properties which may be eligible for inclusion in the National Register of Historic Places. A literature search was conducted for the Red River Backwater portion of the project, but this was not done for the Sicily Island and Bushley Bayou Areas. A total of 75 sites were previously recorded in the Red River Backwater Area prior to the GSRI study. An on-the-ground survey was conducted in the Sicily Island and Bushley Bayou areas. Sixty-one prehistoric and 14 historic sites were recorded in the Sicily Island area (1,000-foot corridor, 500 feet either side of the proposed levee alignments). The on-the-ground survey along Bushley Bayou revealed 15 prehistoric and 5 historic sites.

Gulf South Research Institute
1975 Bayou Cocodrie Archeological Survey

Comments: One significant site (16C050) was located, but once discovered, the site area was eliminated from survey area. Study area extended along Bayou Cocodrie from the proposed floodgate to the proposed cutoff.

Marshall, Richard A.
1977 Cultural Resource Survey of Tensas-Cocodrie Item 3-B and 1, Concordia Parish, Louisiana

Comment: Survey located an area of possible Civil War action in the west end of Grand Cutoff Bayou and cemetery positioned on an Indian mound.

Neitzel, Robert S.
1976 Archeological Survey Report, Proposed Levee Alignments of Red River Backwater Area, Lower Red River

Comment: Two major mound/village/plaza sites in the project vicinity of Levee No. 1, but were not within the rights-of-way. Levee No. 2 intrudes into two major sites near the Spring Bayou end. Three smaller sites were adjacent to the proposed alignment.

Neitzel, Robert S.
1976 Archeological Survey of Items 4 and 5 of Catahoula Lake to Jonesville Levee

Comment: Rights-of-way along French Fork and Little River were examined. Nine sites were located.

Neitzel, Robert S.
1976 Archeological Reconnaissance of Item 3-A Tensas-Cocodrie Levee Enlargement, Mile 24 to Mile 27 on Red River

Comment: No cultural resources were located.

Neitzel, Robert S.
1978 Archeological Survey - Item 5, Acme to Blackhawk Levee Enlargement, Lower Black and Red Rivers

Comment: Although no cultural resources were located in the project rights-of-way, several sites were noted in the general vicinity.

Neitzel, Robert S.
1978 Cultural Resource Impact Statement, Archeological Survey, Six Mile Bayou Project, Acme, Louisiana, Lower Black River, Concordia Parish

Comments: No significant cultural resources located in the project area (2-mile course encompassing 0.5-mile-wide strip.

Servello, A. Frank
1976 Archeological Survey of the Louisiana-Mississippi River Levee Between Morville and Blackhawk, Louisiana

Comment: Four historic (late 19th C.) archeological sites located within survey area.

ATTACHMENT 2
TERRESTRIAL HABITAT EVALUATION
(Revised 1981)

1. The following is a brief description of the various terrestrial habitats in the project areas:

The project area is comprised of several habitat types including bottom-land forests, wetlands, idle lands, soybean fields, cornfields, cottonfields, and pasturelands. The woodlands are primarily on Sharkey Association flooded soils and include overcup oak-bitter pecan, oak-gum-cypress, redgum-mixed hardwoods, and oak-mixed hardwood associations. These woodlands provide generally good wildlife habitat for a variety of wildlife species. These woodland associations have fair to very good mast bearing trees and understory diversity and cover. Ground cover was sparse to good depending upon location and was fairly diverse. Tree size ranged considerably and all woodlands are seasonally flooded. The agricultural lands are essentially monocultures and the average field size is about 360 acres. These fields are poor to good wildlife habitat for a variety of species. The fields are seasonally flooded and occur on Sharkey Association flooded, Sharkey Association, and Calhoun-Calloway Association soils.

2. Computations for man-day use factors for all bottom-land hardwoods:

a. Big game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Turkey	1/70	1/280	22.9	.08
Deer	1/20	1/60	15.6	.26
			Total =	.34
			Use	.34

b. (1) Small game (dry).

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/1.6	1/4.8	.56	.32
Quail	1/18	1/28	.59	.02
Squirrel	1/2	1/6	.67	.11
Raccoon	1/12	1/48	.76	.016
Opossum	1/1.5	1/6	.70	.12
			Total =	.586
			Use	.59

b. Small game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/4	1/12	1.56	.13
Quail	1/30	1/60	0.59	.01
Squirrel	1/6	1/13	0.67	.05
Raccoon	1/20	1/76	0.76	.01
Opossum	1/4	1/14	0.70	.05
			Total =	.25
			Use	.25

c. Wildlife-oriented recreation (estimated).

1.00 man-day/acre/year (flooded)
.83 man-day/acre/year (dry)

4. Computations for man-day use factors for agricultural lands (based on average farm size of 360 acres).

a. "Edge" of cottonfields.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/2.5	1.8	1.56	.208
Dove	1/2.5	1/5	0.14	.026
Quail	1/1.6	1/3	0.59	.184
Fox	1/200	1/100	9.80	.098
Raccoon	1/11	1/25	0.76	.030
Opossum	1/1.25	1/5	0.70	.140
			Total =	.686
			Use	.69

Note: "Edge" of 1 field = 1.7 acres.
A 360-acre cottonfield will provide 1.2 total man-days use.

(2) Small game (seasonally flooded)

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/2	1/6	1.56	0.26
Quail	1/22	1/37	0.59	0.016
Squirrel	1/2	1/6	0.67	0.11
Raccoon	1/10	1/40	0.76	0.019
Opossum	1/1.25	1/5	0.70	0.14
			Total =	0.545
			Use	0.54

c. Waterfowl (when flooded).

Population/acre[a/]	Harvest/acre	Effort for One	Man-day/acre/year
2.5/1	1/2	.38	.19
		Use	.20

a/ Includes wetlands.

d. Wildlife-oriented recreation (estimated).

1.0 man-day/acre/year (flooded)
.83 man-day/acre/year (dry)

3. Computations for man-day use factors for wetlands.

a. Big game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Turkey	1/111	1/444	22.9	.05
Deer	1/33	1/99	15.6	.16
			Total =	.21
			Use	.21

5. Computation of man-day use factors that can be applied to all agricultural lands in the Sicily Island project area.

Item	Number of Fields	Total Man-days
Cotton	10	12
"Idle" lands	6	1,188
Pasturelands	14	658
Soybeans and corn	121	8,954
	Total =	10,812

10,812 ÷ 54,770 acres = .19 man-days/acre

6. Waterfowl usage on flooded soybean fields.

Population/acre	Harvest/acre	Effort for One	Man-day/acre/year
2.5/1	1/2	.38	.19
		Use	.20

7. Small game man-day use factors that can be applied to all flooded agricultural lands in the Sicily Island project area.

a. "Edge" of cottonfields same 360 acres = 1.2 man-days.

b. "Idle" lands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/1.4	1/4	1.56	.38
Dove	1/2.5	1/5	0.14	.02
Quail	1/1.1	1/2	0.59	.27
Fox	1/200	0	9.80	0
Raccoon	1/11	1/50	0.76	.02
Opossum	1/1.4	1/6	0.70	.12
		Total =		.81
		Use		.81

b. "Idle" lands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/2.5	1/8	1.56	.20
Dove	1/2.5	1/5	0.14	.03
Quail	1/1.6	1/3	0.59	.18
Fox	1/200	0	0	0
Raccoon	1/11	1/50	0.76	.02
Opossum	1/1.4	1/6	0.70	.12
			Total =	.55
			Use	.55

One average 360-acre "idle" field will provide 198 man-days use.

c. Pasturelands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/10	1/33	1.56	.047
Dove	1/10	1/33	0.14	.004
Quail	1/7	1/14	0.59	.041
Fox	1/1,000	0	9.80	0
Raccoon	1/50	0	0.76	0
Opossum	1/5	1/20	0.70	.035
			Total =	.127
			Use	.13

d. Soybean and cornfields.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/3.3	1/10	1.56	.16
Dove	1/17	1/33	0.14	.004
Quail	1/8	1/17	0.59	.035
Fox	0	0	0	0
Raccoon	0	0	0	0
Opossum	0	0	0	0
			Total =	.19
			Use	.19

9. Wildlife-oriented recreation.

.12 (wet)
.10 (dry)

10. Computations to determine per acre values of furbearers.

a. Light woods.

(1) Seasonally flooded.

Species	Population/ acre	Harvest/ acre	Value/ Pelt ($)	Value/acre ($)
Raccoon	1/17	1/67	22.00	0.32
Spotted skunk	1/200	1/300	3.00	0.01
Striped skunk	1/8	1/33	3.00	0.09
Gray fox	1/250	1/1,000	55.00	0.06
Red fox	1/333	1/250	55.00	0.04
Opossum	1/1.5	1/6	5.00	0.83
Bobcat	1/500	1/2,000	70.00	0.04
			Total	1.39
			Use	$1.40/acre

(2) Dry woods.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Raccoon	1/25	1/100	22.00	0.22
Spotted skunk	1/250	1/1,000	3.00	0.01
Striped skunk	1/12	1/50	3.00	0.06
Gray fox	1/250	1/1,000	55.00	0.06
Red fox	1/333	1/250	55.00	0.04
Opossum	1/2	1/8	5.00	0.62
Bobcat	1/665	1/2,660	70.00	0.03
			Total	= 1.04
			Use	$1.05

c. Pasturelands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/8	1/25	1.56	.062
Dove	1/10	1/33	0.14	.004
Quail	1/5	1/10	0.59	.060
Fox	1/1,000	0	9.80	0
Raccoon	1/50	0	0.76	0
Opossum	1/5	1/20	0.70	.035
			Total =	.161
			Use	.16

d. Soybean and cornfields.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/4	1/11	1.56	.140
Dove	1/17	1/33	0.14	.004
Quail	1/3	1/6	0.59	.099
Fox	0	0	9.80	0
Raccoon	1/50	1/200	0.76	.010
Opossum	1/25	1/100	0.70	.010
			Total =	.263
			Use	.26

8. Small game man-day use factors that can be applied to all flooded agricultural lands in the Sicily Island project area.

Item	Number of Fields	Total Man-days
Cotton	10	12
Idle lands	6	292
Pasture	14	806
Soybeans and corn	121	10,648
		11,758

11,758 ÷ 54,700 acres = .21 man-days/acre/year

(2) Dry lands.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Raccoon	1/83	1/333	22.00	0.07
Spotted skunk	1/250	1/1,000	3.00	0.01
Striped skunk	1/25	1/100	3.00	0.03
Gray fox	1/2,500	1/10,000	55.00	0.01
Red fox	1/500	1/2,000	55.00	0.03
Opossum	1/625	1/2,500	5.00	0.00
Bobcat	1/1,230	1/4,920	70.00	0.01
			Total	0.16
			Use	0.16

11. Computations to determine man-day use factors under management conditions.

a. Big game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Turkey	1/52	1/208	22.9	.11
Deer	1/15	1/45	15.6	.35
			Total =	.46
			Use	.46

b. Small game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/1	1/3	1.56	.52
Quail	1/15	1/33	0.59	.02
Squirrel	1/1.5	1/4	0.67	.17
Raccoon	1/8	1/32	0.76	0.02
Opossum	1/1	1/4	0.70	.18
			Total =	.91
			Use	.91

b. Wetlands.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Beaver	1/12	1/50	11.00	0.22
Muskrat	1/6	1/23	3.00	0.13
Nutria	1/6	1/23	3.00	0.13
Mink	1/33	1/133	20.00	0.15
Raccoon	1/12	1/50	22.00	0.44
Spotted skunk	1/77	1/300	3.00	0.01
Opossum	1/25	1/10	5.00	0.52
Bobcat	1/1,000	1/3,500	70.00	0.02
Red fox	1/1,000	1/2,750	55.00	0.02
			Total =	1.64
			Use	$1.60

c. Agricultural lands.

(1) Flooded lands.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Raccoon	1/50	1/200	22.00	0.11
Spotted skunk	1/83	1/333	3.00	0.01
Striped skunk	1/12	1/50	3.00	0.06
Gray fox	1/1,250	1/5,000	55.00	0.01
Red fox	1/500	1/2,000	55.00	0.03
Opossum	1/500	1/2,000	5.00	0.01
Bobcat	1/1,500	1/6,000	70.00	0.01
			Total =	0.24
			Use	$0.25

MAN-DAY DERIVATIONS BY HABITAT TYPE
BELOW RED RIVER, LOUISIANA (cont)

Habitat Type	Population Density (Individuals/Acre)	Sustained Annual Harvest Rate (%)	Harvestable Population (Individuals/Acre)	Hunter Success Rate (Man-Day/Individual	Man-Day Value (Man-Day/Acre)
Openland					
Big Game	0.0	0	0.0	0.0	0.0
Squirrels	0.0	0	0.0	0.0	0.0
Rabbits	0.33	60	0.20	0.13	0.026
Raccoon	0.0	0	0.0	0.0	0.0
Waterfowl	0.05	25	0.0125	0.67	0.008
Wildlife-Oriented Recreation	0.07	0	0.0	0.0	0.07
Fur Harvest (Pelts)					(0.044)
Total Man-Day Value/Acre					0.104

MAN-DAY DERIVATIONS BY HABITAT TYPE
BELOW RED RIVER AREA, LOUISIANA

Habitat Type	Population Density (Individuals/Acre)	Sustained Annual Harvest Rate (%)	Harvestable Population (Individuals/Acre)	Hunter Success Rate (Man-Day/Individual	Man-Day Value (Man-Day/Acre)
Bottom-Land Hardwoods					
Big Game	0.05	33	0.0165	24.0	0.396
Squirrels	1.30	60	0.78	0.55	0.429
Rabbits	0.5	60	0.3	0.13	0.039
Raccoon	0.01	45	0.0045	0.96	0.004
Waterfowl	0.10	25	0.025	0.67	0.017
Wildlife-Oriented Recreation	0.6	0	0.0	0.0	0.6
Fur Harvest (Pelts)					(0.17)
Total Man-Day Value/Acre					1.485
Other Wetlands					
Big Game	0.001	33	0.003	24.0	0.008
Squirrels	0.0	0	0.0	0.0	0.0
Rabbits	0.0	0	0.0	0.0	0.0
Raccoon	0.012	45	0.005	0.96	0.005
Waterfowl	4.52	25	1.13	0.67	0.76
Wildlife-Oriented Recreation	0.5	0	0.0	0.0	0.5
Fur Harvest (Pelts)					(0.25)
Total Man-Day Value/Acre					1.273

ATTACHMENT 3
Economic Analysis

Atchafalaya Basin Study

1. Introduction. Information herein pertains to the economic evaluation of altering the operation of the Old River Control Structure (ORCS) for flood control purposes in the Red River Backwater Area. The evaluation was based on the period of economic analysis (1991-2090), the period beginning with the estimated date for modified project operation and continuing through the economic project life. As set forth in EC 1105-2-12, flood damages were determined for with and without modified operation procedures. The periods evaluated include 1978 (present, the year in which this analysis was completed), 1991 (base year, the year that the project becomes operational), and two additional incremental periods, 2020 and 2040.

2. Evaluation Procedure. The flood damage evaluation was accomplished by frequency analysis using previously collected survey data, recorded stages and durations of flooding, hydrologic data, and applicable flood analysis curves. Flood analysis curves were prepared for the areas studied to provide an accurate means of converting various types of damage to an average annual basis. These curves depict the relationship between stage and area inundated, stage and frequency of occurrence, area inundated and frequency of occurrence, crop damage and season of the year, stage and damage, and damage and frequency of occurrence.

3. Data Sources. Major input to the evaluation of damages and benefits was obtained from recent and ongoing studies. The total area studied consists of twelve individual areas, eight of which are currently involved in various stages of analysis for specific improvements. The remaining four are involved in comprehensive studies of more general nature, but include extensive data collection. Data analysis reveals that major flood damages are sustained by agricultural properties including crops and noncrop items such as drainage systems, roads, fences, etc. Roads and bridges also incur substantial losses as do structural properties such as residences, commercial and industrial properties, and similar improvements. Additional information on data source and usage is presented throughout this analysis.

4. Base Conditions and Alternatives. Six alternatives have been evaluated and are referred to herein as Alternatives 35, 40, 45, 35 no head, 65-35, and 60-40. Future as well as present hydrologic conditions are included in the analysis. Thus, the base condition (without-project modification) as well as the effect of each alternative vary over time. Total benefits for Alternative 35, for example, consist of present level benefits (representing the effect of Alternative 35 under present hydrologic conditions upon the present base) plus discounted future benefits (representing the effect of Alternative 35 under future hydrologic conditions upon the future base). A major element in the analysis was

that authorized projects, including Bushley Bayou, Sicily Island, and Below Red River, were not considered in operation. Additional description of the base conditions and alternatives included in this analysis is as follows:

a. Base Conditions.

(1) Present Base. Gate control of the ORCS is operated to maintain a 70/30 percentage distribution of total latitude flows between the Mississippi River and the Atchafalaya River. The hydraulic head on the structure must be equal to or less than 20 feet, and the flow past the Morganza Floodway must not exceed 1.5 million cubic feet per second.

(2) Future Base. The ORCS is operated as with the present base using Simmesport and Red River landing rating curves furnished by NOD to simulate future channel conditions.

b. Alternatives.

(1) Alternative 35 (Present and Future). For Alternative 35 Present, the ORCS is operated to maintain Acme stages at or below 35 feet, mean sea level, when possible, while not exceeding head or flow limitations. For Alternative 35 Future, the ORCS is operated to keep Acme at or below 35 feet, mean sea level, when possible, using future channel conditions.

(2) Alternative 40 (Present and Future). Alternative 40 is similar to 35, except stages at Acme are maintained at or below 40 feet, mean sea level, when possible, within head and flow limits.

(3) Alternative 45 (Present and Future). Alternative 45 is similar to 35, except stages at Acme are maintained at or below 45 feet, mean sea level, when possible, within head and flow limits.

(4) Alternative 35 No Head (Present and Future). The ORCS is operated to keep stages at Acme at or below 35 feet, mean sea level, when possible, based on flow constraints only.

(5) Alternative 65-35 (Present and Future). ORCS is operated to maintain a 65-35 percent distribution of total latitude flows between the Mississippi and Atchafalaya Rivers. Head and flow constraints remain the same as with base conditions.

(6) Alternative 60-40 (Present and Future). ORCS is operated to maintain a 60-40 percent distribution of flows. Head and flow constraints are the same as with base conditions.

5. Total and cleared acres flooded by various frequency floods are presented in Table 1. One particularly significant point is that the 3-year flood inundates almost two-thirds of total lands and over one-third of all cleared lands.

TABLE 1
ATCHAFALAYA BASIN STUDY
ACRES FLOODED
FOR SPECIFIED FREQUENCY FLOODS
PRESENT BASE CONDITIONS

Alternative	Total Acres				Cleared Acres			
	1 Year	3 Year	20 Year	500 Year	1 Year	3 Year	20 Year	500 Year
Red River Backwater Area	253,718	540,084	743,595	848,026	26,808	100,634	209,151	275,076
Percent of Total Area	29.9	63.7	87.7	100.0	9.8	36.6	76.0	100.0

6. Damages - General. Flood damages were estimated for four damageable categories (agricultural crops, agricultural noncrop, roads and bridges, and structural properties). Damages for the first two categories were calculated using a per-acre damage value applied to average annual acres flooded. Damages to the last two categories were determined through preparation of stage-damage curves and integration of these curves with stage-frequency curves to establish damage-frequency relationships. In each case, damages were estimated for both base and with-project conditions.

7. Agricultural Crop Damages.

a. Annual crop damage under present conditions (1978) was determined by multiplying the damage per cleared acre flooded by the average annual cleared acres flooded. The per-acre damage value was calculated by computer analysis utilizing historical flood data, crop distributions and yields, crop budget data, and stage-area data. Program results include the monetary damage to each crop caused by each flood over the historical period of record. The total damage to all crops by all floods divided by the total acres flooded yielded an average damage per flooded acre which ranged from $22.62 to $58.33.

b. Average annual cleared acres flooded were determined by frequency analysis through integration of the stage-area and stage-frequency curves. Results indicate that 98,300 cleared acres are flooded annually under base conditions. Application of acres-flooded values

to the per-acre damage estimate yielded crop damages of $2,915,800 in the study area under base conditions. Crop damage estimates are presented in Table 2. Similar estimates were made for with-project conditions. Calculation of future damage values for crops, as well as noncrop items, was based on projected value of farm products sold for an eight-parish area representative of the Red River Backwater Area.

TABLE 2
ATCHAFALAYA BASIN STUDY
FLOOD DAMAGES BY CATEGORY
PRESENT BASE CONDITIONS

Alternative	Agri. Crop	Agri. Noncrop	Road & Bridge	Structures	Total
Red River Backwater Area	2,915,800	342,900	850,300	1,125,000	5,234,000
Percent of Total	55.7	6.6	16.2	21.5	100.0

8. Agricultural Noncrop. Flood damage to farm property other than crops includes damage to fences, drainage systems, farm roads, and land leveling. In the damage evaluation, a composite damage factor per cleared acre flooded for noncrop items was determined and applied to average annual cleared acres flooded to derive annual damages. In calculating the composite factor, the amount of each damageable item per cleared acre was multiplied by the per-unit value, the result of which was applied to percent damage factors to derive per-acre damage to each item. The amount of each damageable item per acre was based

on recent or current studies in the Red River Backwater Area. Soil Conservation Service data were used to estimate the percent flood damage to each item. Individual damages were then summed to arrive at a composite damage factor to noncrop items per cleared acre flooded which ranged from $2.83 to $4.92, depending upon the area involved. Application of the damage factors to average annual acres flooded yielded total damages of $342,900 to the noncrop category under base conditions (see Table 2). Projected value of farm products sold was then utilized to calculate values for future periods.

9. Roads and Bridges. Determination of road and bridge damages involved preparation of stage-damage values for each area and integration of these data with stage-frequency data to construct damage-frequency relationships. In preparing the stage-damage data, previous studies delineating specific floods upon topographic maps were used extensively to estimate the miles of paved and gravel roads at various elevations. The damage per mile by type of road was based on actual damages sustained in and around the area as determined by recent analyses. Computer analysis of the damage-frequency curve yielded existing total annual damages of $850,000 to roads and bridges in the area. As a reflection of projected population trends for the area, road and bridge damages are considered to remain constant throughout the study period.

10. Structural Damage.

a. Land use in the area is similar to other areas of the Mississippi River Delta in that use for agricultural purposes predominates. Extensive rural development in the form of farm residences, associated buildings, etc., occurs throughout the region. Real estate appraisals of property within the study area have been conducted to determine type, number, value, and evaluation of structures. Future land use in the area is expected to parallel that of current use, continuing at a rate determined by personal preferences, economic conditions, seasonal flooding, etc. Thus, data pertaining to number of structures were applied to both present and future periods for with- and without-project conditions.

b. Annual urban and rural structural property damage was determined by use of a computer program entitled Flood Damage for Urban Areas. Input to the program included type, use, descriptive data, value, and estimated floor elevation of each structure affected; with- and without-project hydraulic (stage-frequency) data; and estimated contents value for each type of structure. Stage-damage relationships for various structure types, use, and value are incorporated within the urban damage program. Damage to contents is also considered within the program, with contents calculated as a percent of structural value.

For residential structures, contents were considered to be 40 percent of structure value. Table 2 includes total existing damages to urban and rural structures. Based on guidelines set forth in ER 1105-2-351, application of an affluence factor in the analysis of rural structure damage is not appropriate.

11. Benefits. Following the guidelines of ER 1105-2-351, benifits were based on the period of economic analysis, the period beginning with the estimated initial project operation date and continuing through the economic life of the project (1991-2090). In addition, benefits herein reflect a 50-year growth period and an interest rate of 6-5/8 percent. This rate was applied through appropriate discounting procedures to convert benefits to an average annual basis. Benefits are presented on an average annual basis for each alternative and benefit category. Two major categories of flood control benefits have been evaluated--flood damage reduction (inundation) and intensification.

a. Inundation Benefits. Inundation benefits consist of reduction in damages to development expected to exist under present conditions at the beginning of project operation, and the reduction of damages to additional development under without-project conditions. This reflects additional development anticipated during the period of economic analysis under existing growth conditions. Flood damage reduction

benefits were evaluated on four damageable categories: agricultural crops, agricultural noncrop, roads and bridges, and structural properties. These benefits are based on the difference between without-project damages, summarized in Table 2, and damages remaining after project installation. These values were used to calculate flood damage reduction benefits for 1978 (present year), 1991 (base year), and for 2020 and 2040. Future benefits were converted to average annual values using discounting procedures computerized by personnel of the Lower Mississippi Valley Division. Average annual damage reduction benefits are summarized by alternative benefit category in Table 3 or in the situation of induced damages in Table 4. The percent contribution to total benefits by each benefit category is also included in these tables. The level of inundation benefits vary from $3,093,800 for Alternative 35 No Head to the point where induced damages of $3,533,000 result from Alternative 60-40.

b. Intensification Benefits. Intensification benefits result from development potentials created by the project. Flood protection, whether full or partial, reduces the risk involved in farming and allows an intensification in agricultural activities which results in higher yields and, subsequently, greater net returns to land. Intensification benefits as a result of modified operation of the ORCS reflect increases in net productive value per acre which

TABLE 3
ATCHAFALAYA BASIN STUDY
AVERAGE ANNUAL BENEFITS
BY BENEFIT CATEGORY

Alternative	Benefits by Category						Total Average Annual Benefits
	Flood Damages Prevented				Intensification		
	Agri. Crops	Agri. Noncrop	Road & Bridge	Struc-tures	Increased Net Returns	Land Clearing	
45 Acme	584,500	55,300	75,200	154,200	1,490,100	272,000	2,631,300
Percent of Total	22.2	2.1	2.9	5.9	56.6	10.3	100.0
40 Acme	667,900	75,500	113,600	171,900	1,718,500	394,500	3,141,900
Percent of Total	21.3	2.4	3.6	5.5	54.7	12.5	100.0
35 Acme	670,200	86,400	158,600	179,700	1,765,800	525,400	3,386,100
Percent of Total	19.8	2.6	4.7	5.3	52.1	15.5	100.0
35 No Head	2,296,500	214,100	361,300	221,900	6,583,800	1,285,600	10,963,200
Percent of Total	20.9	2.0	3.3	2.0	60.1	11.7	100.0

TABLE 4
ATCHAFALAYA BASIN STUDY
AVERAGE ANNUAL INDUCED DAMAGES
BY DAMAGE CATEGORY

Alternative	Induced Damages by Category						Total Average Annual Induced Damages
	Flood Damages Induced				Reduced Intensification		
	Agri. Crops	Agri. Noncrop	Road & Bridge	Struc-tures	Net Returns	Land Clearing	
65-35 Alternative	1,416,100	129,100	157,900	456,100	3,229,700	0	5,388,900
Percent of Total	26.3	2.4	2.9	8.5	59.9	0	100.0
60-40 Alternative	2,347,200	217,600	251,600	716,600	6,392,900	0	9,925,900
Percent of Total	23.6	2.2	2.6	7.2	64.0	0	100.0

result from better use of the land protected from frequent flooding. Intensification benefits will result from increased agricultural yield levels and conversion of woodland to cropland.

(1) Benefits From Increased Yield Levels. With the use of crop budgets, land use data, and yield level estimates the net returns to all crops were computed for conditions with and without the project. Those acres which are presently being intensively farmed or which will incur frequent flooding under with-project conditions were eliminated from consideration. A difference in the net productive value per-acre with and without the project was calculated for each area. The greatest increase in net productive value per cleared acre ($48.53) occurred in the Below Red River Area. Application of these per-acre values to the number of cleared acres enhanced yielded the basic benefit values for the various alternatives. The benefits were then adjusted to account for increased damages on those acres flooded after project installation and the degree of protection afforded by the project. A similar procedure was used to establish increased net return benefits for future periods. Future values were then converted to an average annual basis by the same methodology used for discounting crop inundation benefits. Average annual net return benefits by alternatives area are presented in Table 3.

(2) Benefits From Conversion of Woodland to Cropland. Frequent flooding of a substantial portion of the woodland acreage hinders the conversion of these lands to agricultural use. Under base conditions, 439,450 wooded acres or about three-fourths of the total woodland in the area is subject to flooding by a 3-year frequency flood. With the reduction in flooding to be provided by four of the six plans of modified project operation, farmers would be able to convert woodland to cropland economically. Project-induced clearing by alternative is presented in Table 5. The estimated acres of woods to be cleared due to each modification were calculated using a composite factor based on the reduction in average annual wooded acres flooded and data obtained from land-use surveys for individual studies in the Red River Backwater Area. The composite factor was applied to the number of wooded acres subject to flooding from the 20-year frequency flood under existing conditions but above the 1-year frequency flood under with-project conditions. The acres were then adjusted to account for degree of protection afforded by each alternative. The number of acres to be cleared was applied to the increase in net productive value per acre to determine annual benefits which were then adjusted to account for damages remaining under each alternative. Average annual benefits to project-induced clearing are included in Table 3. The amount of induced land clearing benefits was restricted by relatively low degrees of

protection on woodland, varying from a high of 42 percent for Alternative 35 No Head to an increased flooding hazard under Alternatives 65-35 and 60-40. In addition to the above, an analysis was conducted to estimate the induced clearing which resulted from going to the present method of operating ORCS (true 70-30 split) as opposed to the previous method for operation (referred to as the observed condition). An estimated 4,900 acres was determined in this analysis.

TABLE 5
ATCHAFALAYA RIVER BASIN
PROJECT-INDUCED LAND CLEARING
BY ALTERNATIVE

Alternative	Alternative				
	35	40	45	35 No Head	70-30
Red River Backwater Area	11,700	7,500	3,900	10,500	4,900

12. Summary of Benefits. Table 6 presents a summary of benefits by alternative. Similarly, Table 6 presents a summary of induced damages for those alternatives creating worse flooding conditions. Total benefits vary from $10,960,000 under Alternative 35 No Head down to induced damages of $9,930,000 under Alternative 60-40.

TABLE 6
ATCHAFALAYA BASIN STUDY
SUMMARY OF AVERAGE ANNUAL BENEFITS
OR INDUCED DAMAGES

Alternative	Benefits ($)	Induced Damages ($)
35 No Head	10,963,200	-
35 Acme	3,386,100	-
40 Acme	3,141,900	-
45 Acme	2,631,300	-
65-35	-	5,388,900
60-40	-	9,925,900

DAVID C. TREEN
GOVERNOR

State of Louisiana

OFFICE OF THE GOVERNOR

Baton Rouge

November 5, 1980

Colonel Tom Sands
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

Enclosed is the recommendation of the State of Louisiana on the Land Use Option for the Final Atchafalaya Basin Management Plan.

The proposal recognizes that the first use of the Atchafalaya Basin is as a floodway. Within this context, the state's proposal provides fair and equitable treatment to all of the varied interests concerned with the future of the Atchafalaya Basin. I hope that in developing the Final Management Plan the Agency Management Group will give serious consideration to the proposals of the State of Louisiana.

With warm regard, I am

Sincerely,

David C. Treen

DCT/lmh

enclosures

ATTACHMENT 2

DAVID C. TREEN
GOVERNOR

State of Louisiana

OFFICE OF THE GOVERNOR

Baton Rouge

STATE OF LOUISIANA
LAND USE PROPOSAL
FOR THE FINAL ATCHAFALAYA BASIN
MANAGEMENT PLAN

Any land use plan adopted for the Atchafalaya Basin must recognize that the basin is first and foremost a floodway. Uses that are inconsistent with the continued use of the basin as a floodway must be prohibited, and actions which are necessary to maintain the basin as a floodway must be given first priority.

The recommended plan involves the obtaining of certain easements over private property in the basin. If in the future it is determined that these easements are no longer necessary, the owner of the property subject to the easements should be given the first option to repurchase them. Where an easement gives the government the right to provide public access to private property, provision must be made to exonerate the private property owner from non-intentional tort liability for incidents arising out of the exercise of that easement.

GENERAL-

Except as specifically provided below, an A-7 Easement should be obtained over all property except developed ridges and State owned property in the basin.

The A-7 Easement would generally provide the following rights in the property:

1) The landowner retains ownership and the right to exploit minerals;
2) The landowner retains the right to control public access;
3) The landowner retains ownership of timber and the right to practice silviculture (as conditioned below);
4) The government would obtain the right to flood the property;
5) The government would control all excavations, landfilling, and uses which change the natural condition of the property (e.g. no clearcutting to convert land to a different use);
6) The government could prohibit permanent habitable structures (other than camps); and
7) Additional uses and structures would be subject to governmental regulation or prohibition.

MINERAL PRODUCTION (OIL AND GAS)-

The A-7 Easement would leave the ownership and right to exploit minerals with the property owner. In accordance with LSA R.S. 31:149, prescription will not run against the property owners. Those rights would have to be exercised in accordance with accepted mineral development practices. It is envisioned that the conditions will be similar to those contained in the Corps of Engineers "Dredge and Fill Permitting Process"(Section 404). Concern has been expressed by certain property owners, particularly the oil and gas industry, that the conditions of exploitation may become so onerous as to be prohibitive. The conditions of exploitation should be worked out in advance and incorporated into the easement and authorizing legislation. The State recommends the conditions contained in Appendix A be so incorporated.

BOTTOMLAND HARDWOODS AND EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS - The A-7 Easement would leave ownership of the hardwoods and the right to practice silviculture with the landowner.

However, the easement should be re-written to specify that those rights would be subject to the following conditions:

1) No land-clearing for conversion to other land uses;
2) No non-regenerative timber cutting; and
3) If silviculture is practiced,it must be on a substainable yield basis.

In addition to the A-7 Easement over the basin, an A-2 Easement should be acquired over 30,000 acres of bottomland hardwoods. The A-2 Easement is the same as the A-7 Easement except:

1) The government would obtain ownership of the bottomland hardwoods; and
2) The government would have the right to provide public access to the property.

The purpose of the A-2 Easement is to set aside this acreage in its natural state and to allow an area of public access for recreation (principally hunting.)

In addition the government should be authorized and encouraged to purchase additional acres on a willing vendor basis.

The acres acquired should be sufficiently contiguous to accomplish the purposes set forth above.

CYPRESS-TUPELO STANDS - The A-7 Easement leaves ownership and right to practice silviculture of Cypress-Tupelo stands with the property owner. Again, this easement would have to be re-written to provide that those rights are subject to the three conditions set forth in the section on Bottomland Hardwoods.

With regard to cypress, however, the condition providing for no non-regenerative cutting should aslo include a provision specifying no clearcutting. Serious concern has been expressed over the regenerative ability of cypress. Apparently, it is very difficult to determine if cypress tree cutting is in accordance with a program of sustainable yield, or is in effect a "mining" operation. It is felt that the prohibition of clearcutting of cypress stands and a vigorous program of monitoring by the Louisiana Office of Forestry is necessary to protect cypress from a possible non-regenerative level of cutting. Federal financial assistance may be necessary to properly monitor sustainable yield cutting.

In addition to the A-7 Easement over the basin, an A-2 Easement should be taken on 20,000 acres of Cypress-Tupelo stands and an A-6 Easement over 30,000 acres of Cypress-Tupelo stands. The A-6 Easement would give the government the right to allow public access to the lands, but retain ownership of the Cypress-Tupelo stands and the right to practice silviculture with the property owner.

It is recommended that the government be authorized and encouraged to obtain additional Cypress-Tupelo stands from willing vendors. Again, the acres should be sufficiently contiguous to accomplish the purposes for which they are acquired.

The conditions for practice of silviculture should be worked out in advance and incorporated into the easement and authorizing legislation.

GREENBELTS- It is recommended that two types of greenbelts be created to provide public access to land areas for recreational purposes. These would be A-2 Easements.

1) Greenbelts along specified public navigable waters - The greenbelt would consist of 300 foot-wide strips of land on each side of specified public navigable waters. It must be emphasized that the designation of public navigable waters would be for the purpose of identifying greenbelt areas and not for the purpose of determining ownership to the water or waterbottoms. The greenbelts should incorporate as much cypress-tupelo acreage as feasible.

2) Perimeter-Greenbelts - These greenbelts would consist of land areas up to 1/4 mile wide along specified areas of land inside and adjacent to the Atchafalaya Basin Guide - Levees. Except as provided below, the right would not include access to the levee. The areas considered would be those in which the 1/4 mile or less width would bring the perimeter greenbelt into contact with water. Certain areas would be specified for controlled access over the levee to the greenbelt.

The designation of a perimeter greenbelt is not to interfere with the governments right to engage in flood control activities on that property. This specifically includes the right to obtain material from the property for levee construction.

The total area set aside for the two types of greenbelts would be 23,000 acres.

The greenbelt property would be subject to the conditions of an A-2 easement. Public access includes the right of owners of property landward of a greenbelt area to cross the greenbelt to exercise on the landward property any right they would have under an A-7 Easement. Also, the existing right of the landowner to establish a camp on his property and fence off a reasonable area for privacy would not be abridge by the obtaining of the A-2 Easement for a greenbelt.

CAMPSITES, BOAT LAUNCH AREAS, ROOKERIES, SPECIAL AND UNIQUE AREAS -

Rookeries - An A-2 Easement should be obtained over 500 selected acres of rookeries.

Campsites, boat launch areas, special and unique areas - An A-1 Easement should be obtained over 1500 acres for campsites, boat launch areas and special and unique areas. An A-1 Easement would give the government fee simple title to the land. However, it would reserve mineral rights to the original property owner. In accordance with LSA R.S. 31:149, prescription will not run against the property owners.

Since the primary method of public access to the basin is by boat, every effort should be made to maximize the number of boat launch areas in the basin.

WATER ACCESS - An important element of public access in the basin is access by water to overflow lands flooded during seasonal high waters. The legal right to this access is unclear. The Louisiana Attorney General is urged to issue a legal opinion clarifying the right of public access by water to overflow lands. If this right does not exist, an A-6 Easement would be necessary to provide comparable access.

STATE OWNED LANDS - The State of Louisiana will maintain the state lands in the basin open for public recreational access. State title shall not be prejudiced by another government's acquisition of an easement from private claimants to any of these same lands. Language to this effect should be incorporated in all easements.

MANAGEMENT - The working group believes that management of non-flood control elements of the final Atchafalaya Basin Plan should be through State of Louisiana agencies.

SUMMARY -

A-7 - Generally over basin

A-6 - 30,000 acres Cypress-Tupelo

A-2 - 30,000 acres Bottomland Hardwoods
20,000 acres Cypress-Tupelo Stands
23,000 acres Greenbelts
500 acres Rookeries

A-1 1,500 acres, campsites, unique and special areas

Total - 105,000 acres

APPENDIX A

Oil and Gas Activities in the Atchafalaya Fish, Wildlife, and Multi-Use Area

The United States Department of the Interior's Fish and Wildlife Service, in proposing the Atchafalaya Fish, Wildlife and Multi-Use Area, recognizes that oil and gas activities would be fully compatible with any operational, multipurpose plan established for that area. It is, therefore, the intent that such activities, within the area, will not be subject to any additional restrictive regulations affecting oil and gas activities.

Furthermore, mineral owners, mineral lessees and pipeline companies shall have the right to use surface and subsurface property of the Atchafalaya Fish, Wildlife and Multi-Use Area as may be necessary for the conducting of operations for the exploration, development, production, storage, transportation and marketing of oil, gas and other liquid or gaseous minerals, including but not limited to, the construction, maintenance and operation of wells, pumping units, pipelines, storage tanks, valves, meters and other above or below ground facilities relating to such exploration, development, production, storage, transportation, or marketing. In addition, this right shall particularly include, but shall not be limited to, the following actions where normally associated with oil and gas exploration, development, production, storage, transportation, or marketing:

(1) access to all parts of the Atchafalaya Fish, Wildlife, and Multi-Use Area on a year-round basis;

(2) access via all navigable waterways;

(3) right to dredge, maintain, and use canals as needed for the exploration for and production and transportation of oil, gas, and other liquid or gaseous minerals;

(4) with respect to the construction, use, and maintenance of production facilities, the right to:

a) dike and fill

b) place facilities on pilings

(5) the right to construct, maintain, operate, and use pipelines and flowlines for the transportation of oil, gas, water (salt or fresh), and other liquid or gaseous minerals. The pipelines and flowlines will be constructed in accordance with standards prevailing in the industry;

(6) where land access is available to a location, the right to construct, use and maintain suitable roads. Water levels in management units shall be regulated, as closely as possible, to simulate natural overflow patterns, thus facilitating coordinated planning of such road locations and elevations with water management plans;

(7) the right to construct, use, and maintain electric utility and telephone lines;

(8) the right to drill, use and maintain wells for the disposal of produced water;

(9) the right to excavate, use, and maintain pits and other facilities normally needed in connection with oil and gas exploration and production operations;

(10) the right to conduct or have conducted geological surveys including those that require the use of explosives;

(11) the right to dispose of drilling muds and other waste in the manner and to the extent required by State and Federal law.

SUMMARY
GOVERNOR'S ATCHAFALAYA BASIN PLAN
PRESS CONFERENCE OF 19 NOVEMBER 1981

A handout furnished the conference attendees contained the following information.

BASIC ELEMENTS

1. Dow donation in excess of 40,000 acres of land in and around the basin.

2. Landowners agreeable to selling the state at least 48,000 plus acres.

3. Tightened A-7 easement to cover the entire basin to prevent conversion of basin from its natural state.

4. 40 percent of the basin will be open to public access.

5. The A-7 easement (flood control) will be funded 100 percent by the Federal government. For recreation, wildlife and other multi-purpose uses, the state is indicating a willingness to share the cost with the Federal government. Cost to the state will be a percentage of $50 to $55 million for land acquisition with the Federal government funding the rest.

6. All major groups involved in the Atchafalaya Basin are supportive of this plan.

Governor David C. Treen made opening remarks. He indicated he had important announcements consisting of several elements regarding the Atchafalaya Basin, news that was very good and exciting for Louisiana. First and most important was the announcement by Dow Chemical Company of a donation of approximately 45,000 acres in and around the basin. Also, an understanding has been reached with prinicpal landowners in the basin for a method of acquisition of 40,000 plus acres in the basin. In addition, an agreement with the environmental community with regards to the A-7 easement has led to the plan which will resolve all of the issues in the basin. All the rest was resolved assuming that this plan can ultimately be put in effect. If so, it would meet all of the needs, aspirations and hopes of all concerned with the Lower Atchafalaya Basin.

Governor Treen introduced Mr. Bill Neeley, the General Manager of the Louisiana Division of Dow Chemical Company, and Mr. Steve Haggard of Dow. Mr. Neeley expressed pleasure at announcing the Dow donation, well in excess of 45,000 acres in or near the basin, for the benefit of the people of Louisiana. It was deemed an appropriate expression of appreciation for the excellent climate and favorable reception experienced by Dow on its 25th anniversary of doing business in the state.

Next Governor Treen explained a map depicting the Dow land donation and land presently owned by the state. He indicated he would answer questions after completion of statements by those wishing to speak. Governor Treen proceeded to give background on the plan. He explained that he made a recommendation to the Agency Management Group in November 1980 that involved flood control,

public access through easements, and tried to address the problem of minimizing the taking of lands in private ownership. He viewed this as the catalyst for the further discussions after learning of Dow's intentions several months ago. There was concern by hunters about the "greenbelts" included in the earlier plan. Other concerns were expressed by wildlife people who preferred full acquisition rather than easements to provide for better management. The discussions were continued with Mr. Trowbridge representing the landowners and he began to identify areas in the basin that they would be willing to sell. Governor Treen identified Alabama Bayou and Henderson, and mentioned scattered acreage throught the basin totaling between 40,000 and 50,000 acres of very prime area. He next explained that under present policies of the administration in Washington, to expect 100 percent Federal funding for this entire plan was not realistic. He expressed belief that the flood control portion will be 100 percent Federal funding. Summarizing developments, the Governor agreed to accept with gratitude the Dow donation; to work with landowners through Mr. Trowbridge to get in writing offers to sell the acreage clearly identified and price discussed; to tighten up the A-7 easement over everything else in the basin; and to seek state and Federal funds on a matching basis. Governor Treen announced that Secretary of the Interior James Watt would tour the basin on Saturday with him and that the media would be invited. He closed by emphasizing that this was a complete plan for multiple uses of the basin and had the support of all those involved, the naturalists, environmentalists, landowners, the Treen Administration, and the people interested in flood control.

Governor Treen then introduced Mr. Newman Trowbridge, representing the Louisiana Landowners Association. Mr. Trowbridge indicated that landowners will find the plan very acceptable. Private property rights will be protected by the willing seller concept, and habitat protection will be provided by the A-7 easement.

Mr. Foster Sanders of Save the Atchafalaya Basin, Inc. was next introduced and announced the support of his and other sportsmen and civic groups for the compromise plan.

Mr. Oliver Houck of the National Wildlife Federation followed, speaking on behalf of many national-based conservation organizations. He stated that the plan would receive strong national recognition and support.

Mr. Charles Frying then spoke on behalf of the Sierra Club and Audubon Society, applauding Governor Treen's efforts in reaching resolution of this very difficult issue.

Mr. Edgar Viellon of the Louisiana Wildlife Federation was introduced and indicated gratitude to all involved in bringing to successful conclusion a 10-year long emotional battle.

Governor Treen acknowledged the work of his staff members, Mr. Kai Midboe, in helping make this announcement a reality, and Mr. Jesse Guidry, who would administer public access of the area. Mr. Guidry reflected back upon a public meeting in 1975, when the same people were there but of opposing interests, and pledged to work toward accomplishing the plan.

The Governor closed the general remarks by emphasizing that at least 40

percent of the basin or 240,000 acres would be preserved for posterity, while meeting the objectives of flood control and legitimate objectives of private ownership.

Significant questions answered by Governor Treen follow.

In explaining the difference between the tightened easement and the one described in the other plan, Governor Treen agreed to support a non-conversion position so that any major industrial, residential or commercial use would require approval by the Congress.

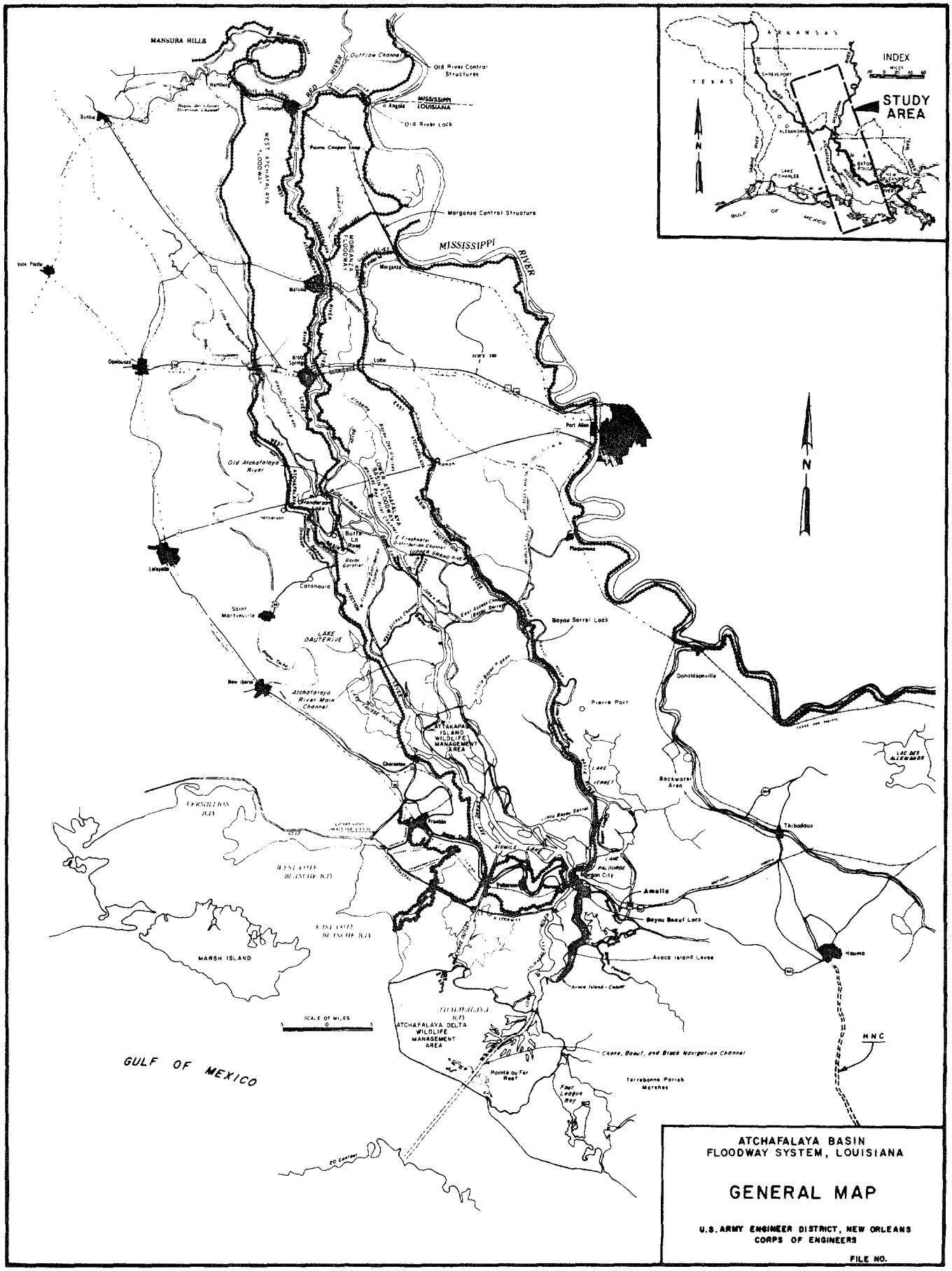
In response to assuming success in concluding the deal with the landowners; what would be the next step, Governor Treen indicated that when written agreements of the landowners were completed and he was satisfied with having a funding mechanism, he would recommend substitution of the compromise plan. He further stated that the Corps of Engineers is very receptive to this substitute, and Federal funding will be required. He indicated that the state legislature will have to approve by appropriation any matching funds, and if the purchase is 50-55 million dollars, the various matches could be figured starting with a 90-10 proposition with the Federal government.

The press conference concluded with questions regarding Secretary Watt's visit.

COMPREHENSIVE MULTIPURPOSE EASEMENT

The perpetual right, power, privilege and easement to overflow, flood and submerge by natural or artificial means for any designated time or indefinite time the lands described herein as Tract Nos. _____, in connection with the operation and maintenance of the _____project as authorized by the Act of Congress approved _____, providing further that there will be no land converted from existing uses for agricultural, industrial, or residential purposes; for activities conducted by the State of Louisiana in its sovereign capacity and for other activities not mentioned in this easement except upon a written finding by the representative of the United States in charge of the project that there is no feasible or prudent alternative to the conduct of these activities within the Floodway; for activities by the State or private interests of a recreational or commercial nature directly related to the use and enjoyment of the renewable natural resources of the Floodway except upon the representative's finding that these activities are fully consistent with the project and the preservation or enhancement of natural conditions, provided that no structures for permanent human habitation shall be constructed or maintained on the land, and provided, further, that construction of seasonal dwellings by private interests shall be permitted with written approval hereunder; for other activities by state and private interests except those necessary for the exploration, production, development, storage, extraction, marketing, and transmission of oil, gas and/or other minerals as described in the referenced appendix, and for the production of timber as described below and in the referenced appendix, and for other activities by private interests except those relating to the mineral, timber, wildlife management and public access rights retained by the landowner under this agreement.

Landowner shall retain title to timber, the right to manage timber on a sustained yield basis following prudent and current state of the art forestry practices, and the right to control ingress and egress relating to the land, and landowner shall retain the right to practice wildlife management, including the right to undertake wildlife habitat enhancement measures and to grant hunting, trapping and fishing leases, reserving, however, to the vendor(s), their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress, or abridging the rights and easement hereby acquired. Provided further, that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill and that any use of the land shall be subject to Federal and State laws with respect to pollution control, environmental protection and fish and wildlife conservation; the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads, pipelines; excepting and excluding all minerals and appurtenant rights; in the event that the Secretary of the Army, his successor or assign shall determine that the useful life of the floodway has ceased to exist and that it is in the public interest, he will execute an appropriate instrument to terminate or release the government's easement to the grantors, their heirs, successors or assigns.



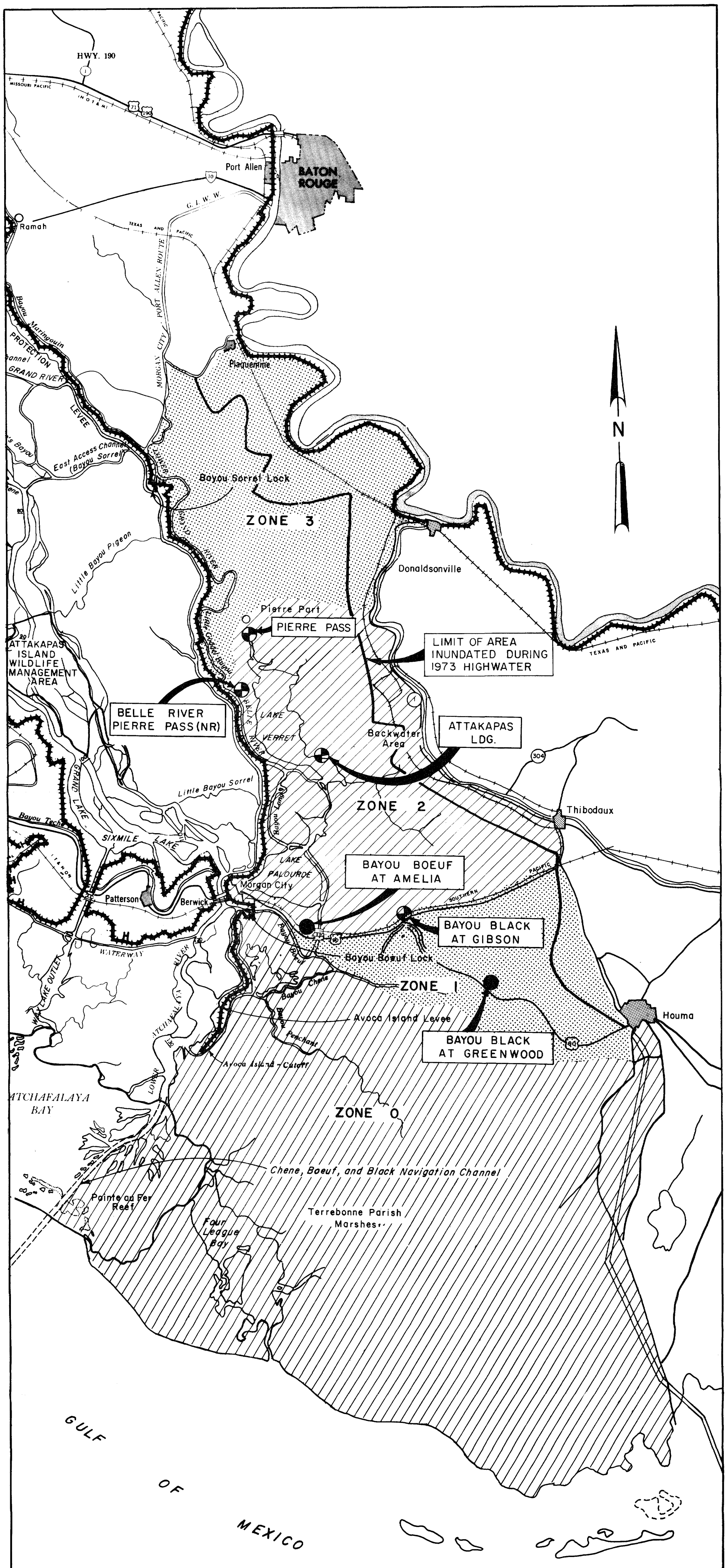
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

GENERAL MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-1



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

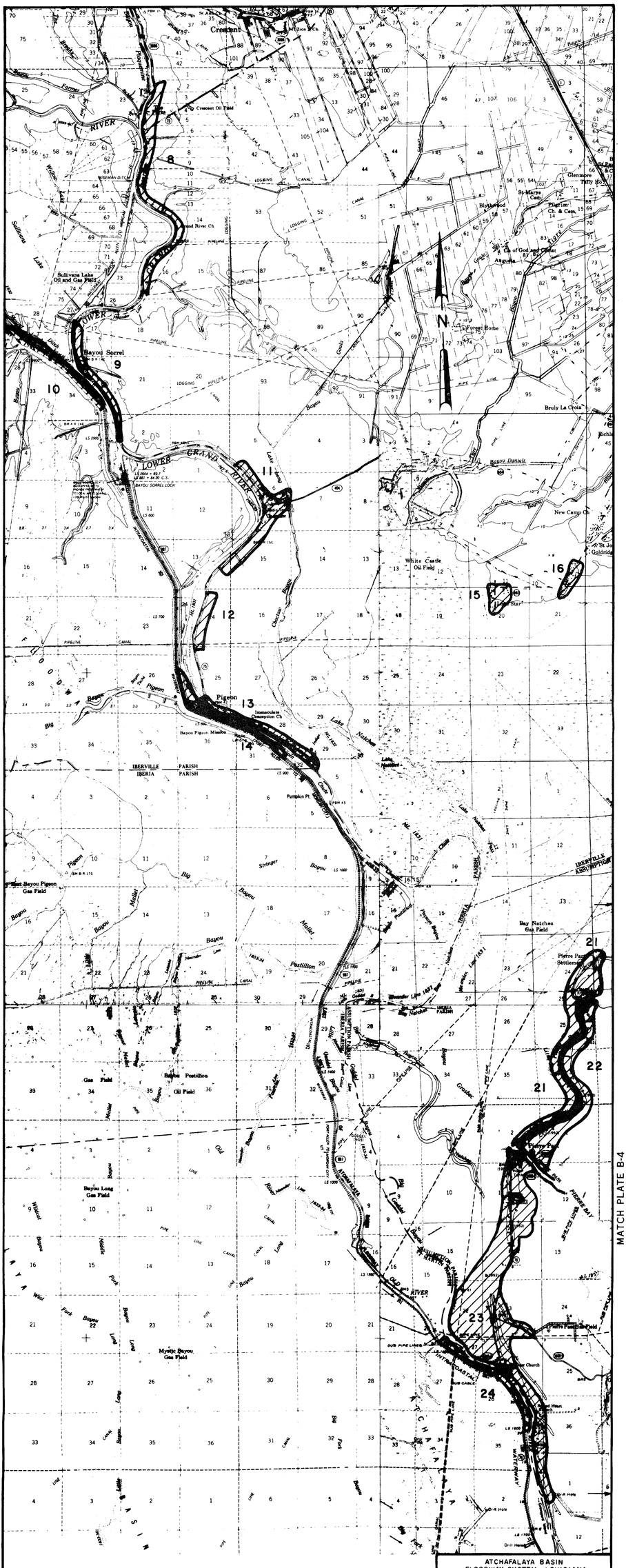
ATCHAFALAYA RIVER
BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-2

PLATE B-2



MATCH PLATE B-4

LEGEND

RINGED AREAS

SCALE OF MILES

1/2 0

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

RING LEVEE ALTERNATIVE FOR BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

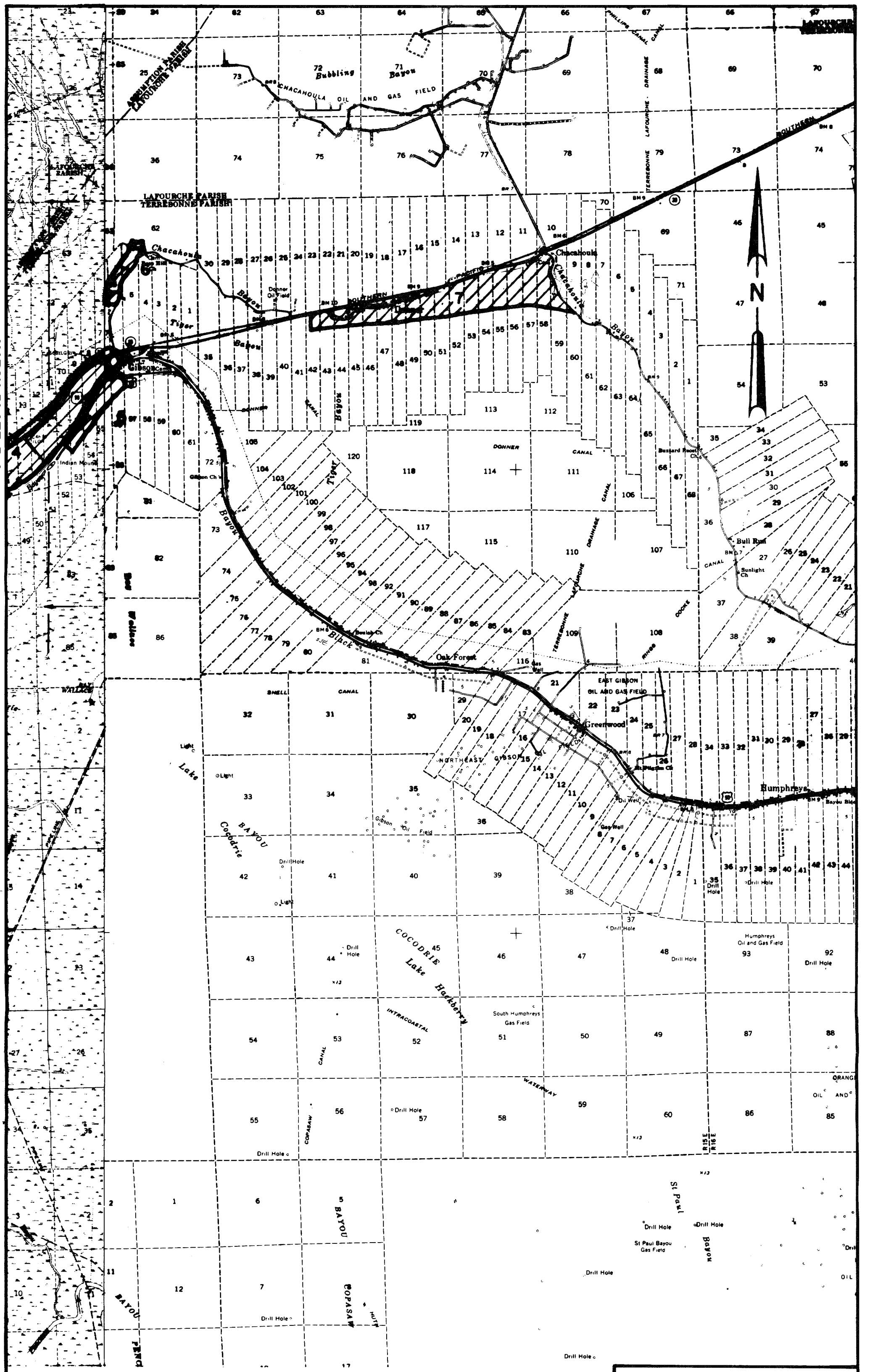
FILE NO

PLATE B-3

PLATE B-3

MATCH PLATE B-3
MATCH PLATE B-5
N
17
18
19
20
25
26
27
28
ASCENSION
ASSUMPTION
Napoleonville Oil and Gas Field
Bayou Corne
Brulé St. Vincent
Paincourtville
Napoleonville
Klotzville
Belle Rose
Magnolia
Little Bayou St. Vincent Gas Field
East Lake Verret Gas and Oil Field
LAKE VERRET
Attakapas Landing
Upper Texas
Bayou Crab
Dwight Fields
BELLE RIVER
BAY HERON
BAY SYLVESTER
BAY MARCALLE
Lower Texas
FIRST BAY
Bayou Geneve
WILLOW LAKE
SECOND BAY
GRASSY LAKE
Stephensville
BAY SHERMAN
LAKE PALOURDE
Simon Pass Gas Field
East Lake Palourde Oil Field
East Lake Palourde Oil and Gas Field
LAKE
PALOURDE
Lake Palourde Gas Field
Amelia
Morgan City Beach
ISLAND
Greenwood
Siracusaville
Lake Bruin
LEGEND
RINGED AREAS
SCALE OF MILES
1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
RING LEVEE ALTERNATIVE
FOR BACKWATER AREA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.
PLATE B-4

PLATE B-4



LEGEND

RINGED AREAS

SCALE OF MILES

1 1/2 0 1

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

RING LEVEE ALTERNATIVE FOR BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-5

PLATE B-5

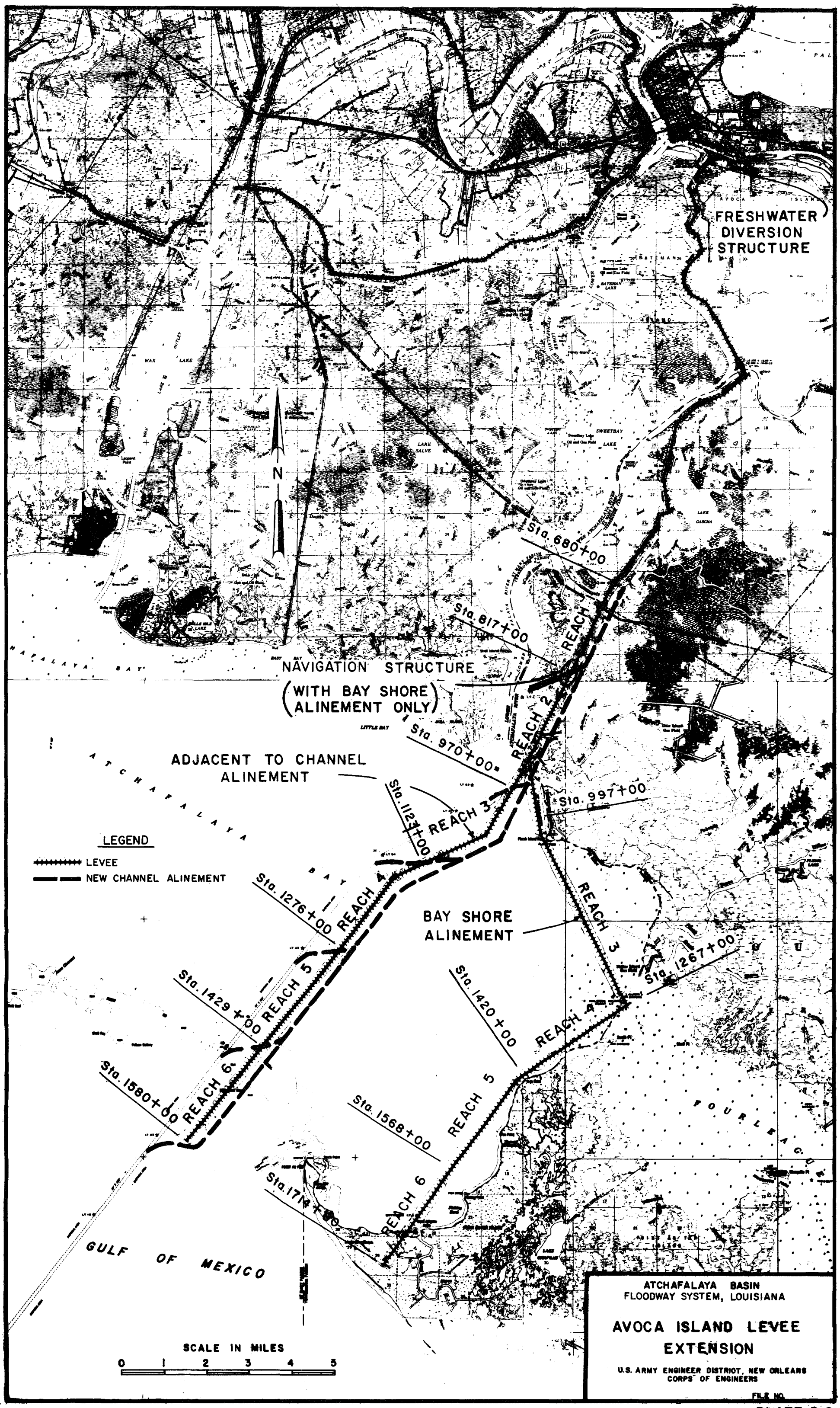
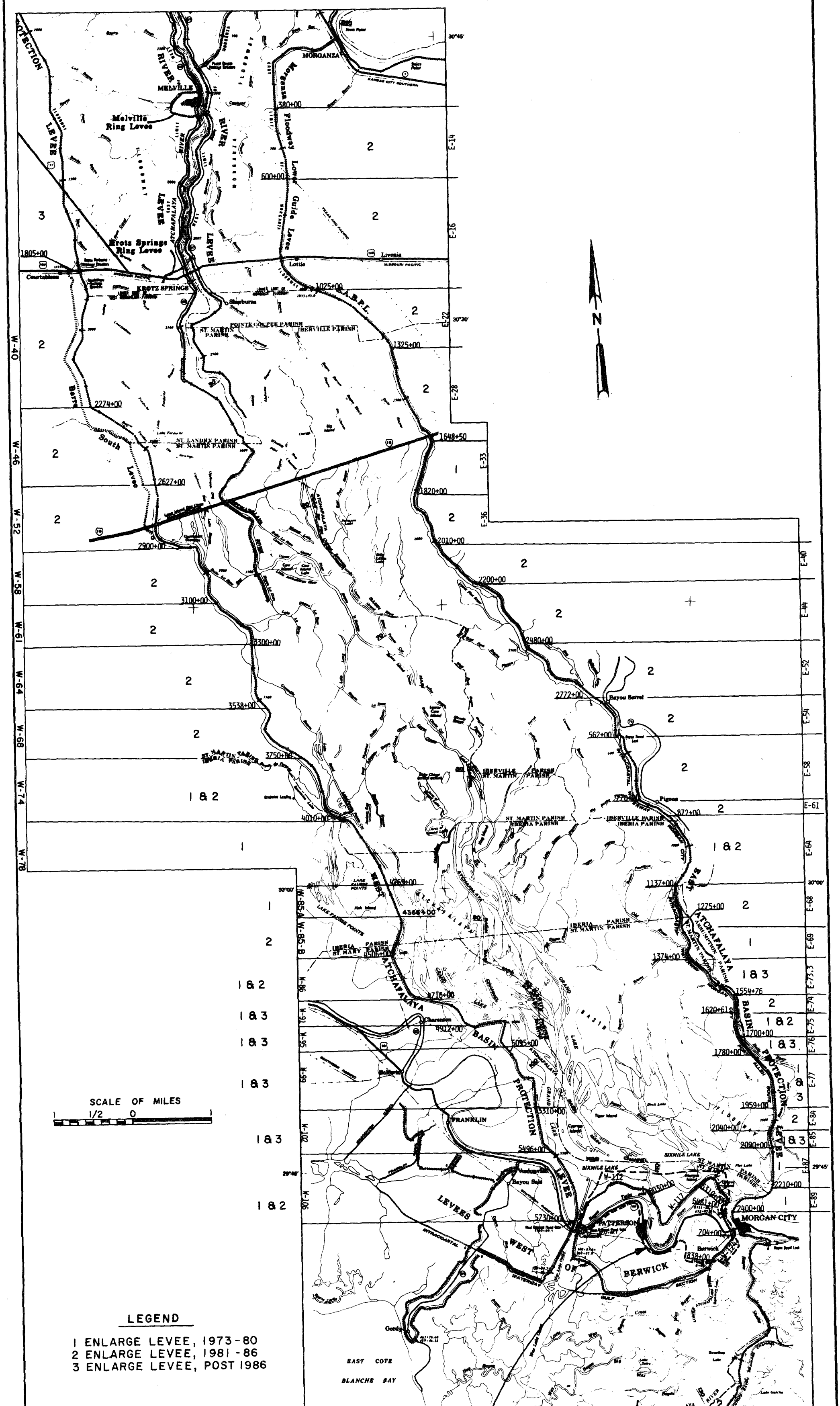


PLATE B-6

PLATE B-6



1 & 2
1 & 3
1 & 3
1 & 3
1 & 3
1 & 2

LEGEND

1 ENLARGE LEVEE, 1973-80
2 ENLARGE LEVEE, 1981-86
3 ENLARGE LEVEE, POST 1986

NOTE: SCHEDULED ENLARGEMENT BASED ON 20 NOV. 1979 PB-2A
MAJORITY OF LEVEE ENLARGEMENT SOUTH OF TECHE RIDGE WILL OCCUR PRIOR TO 1986.

W-112 1 & 3
W-117 1
W-121 1
W-123 2
W-124 2

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MODIFICATION OF EXISTING LEVEE FEATURES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-7

PLATE B-7

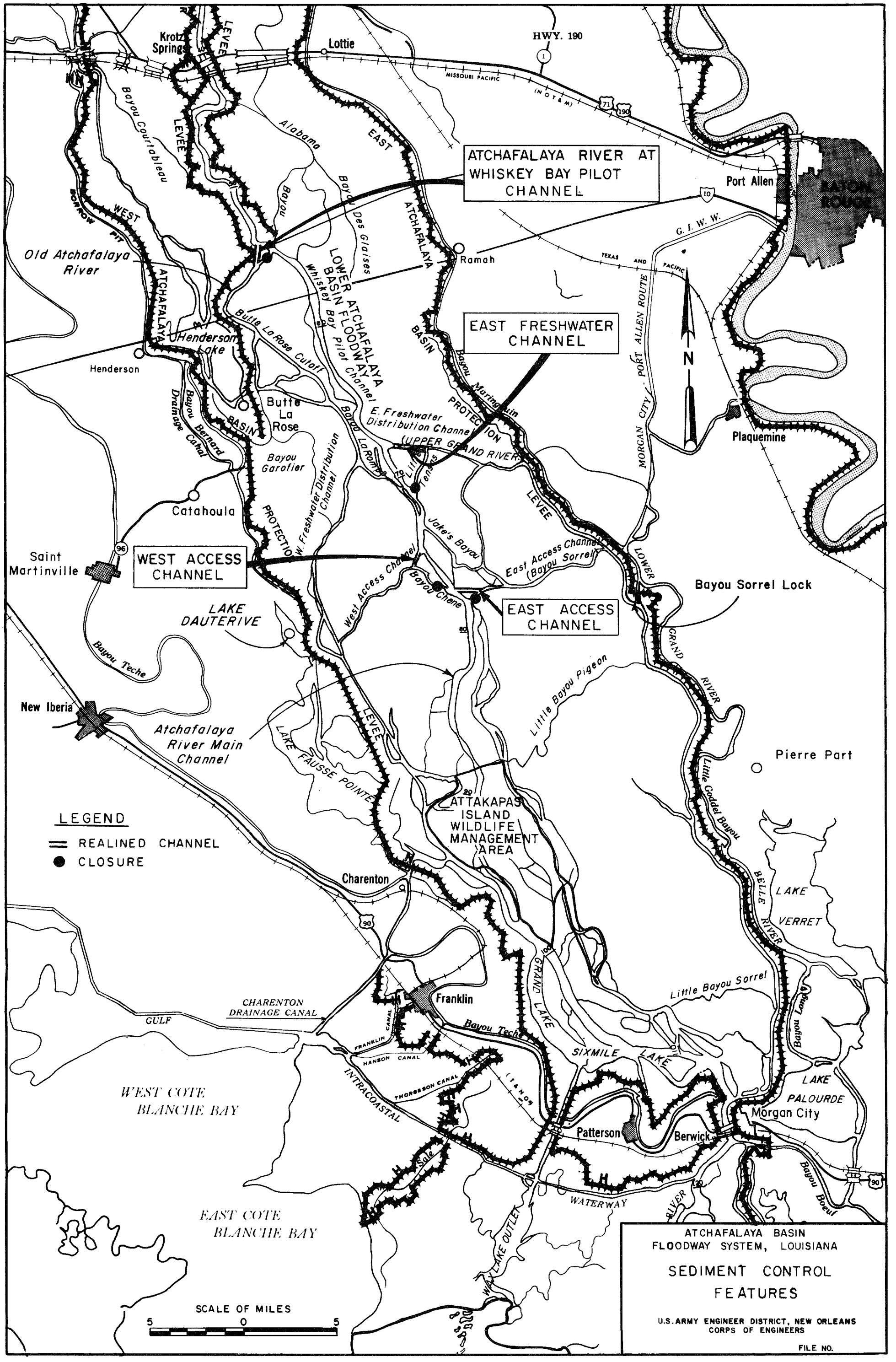


PLATE B-9

PLATE B-9

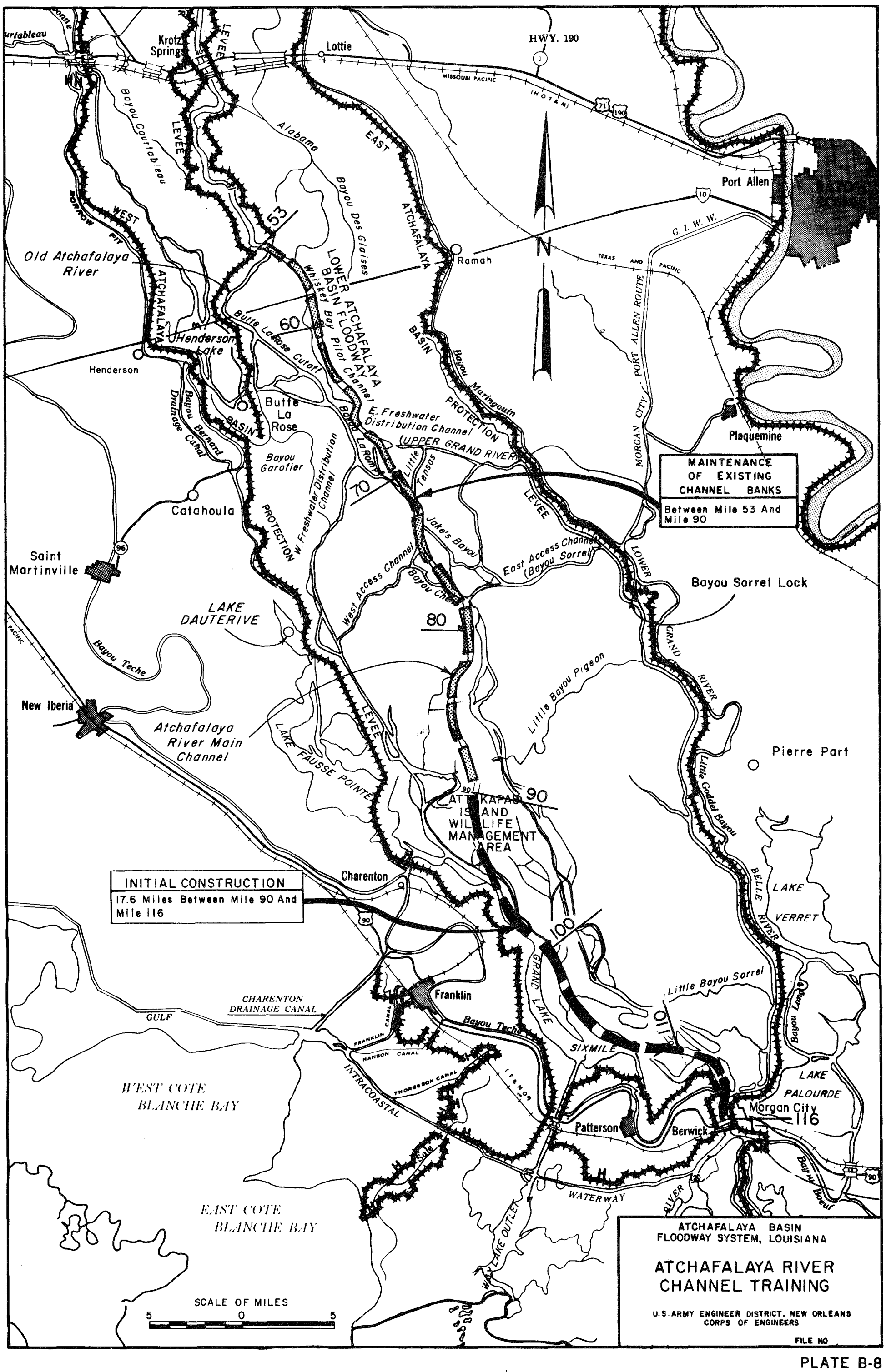
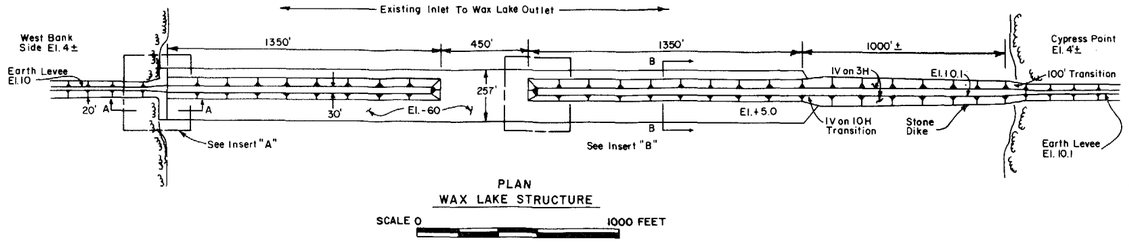


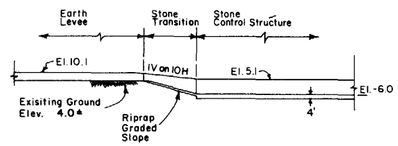
PLATE B-8

PLATE B-8



PLAN
WAX LAKE STRUCTURE

SCALE 0 1000 FEET



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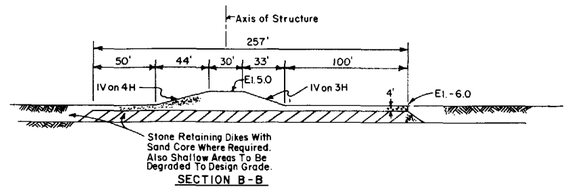
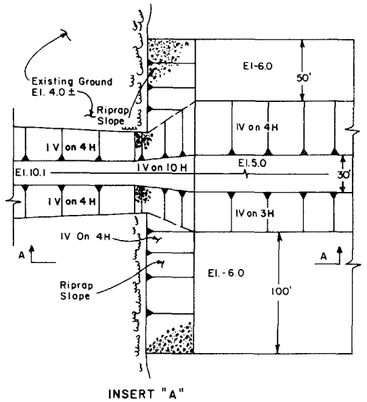


SECTION B-B



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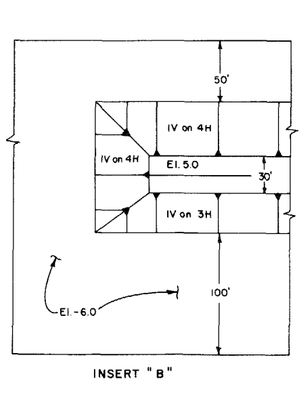

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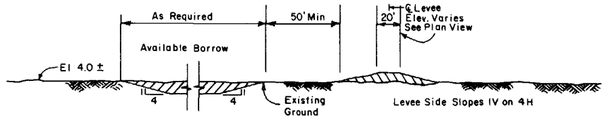


SECTION D-D

SCALE 0 50 100 FEET

Note: The Existing Group Varies Considerably And The Elevation Shown is Not To Be Construed As Average or Typical.

GENERAL NOTES

1 All Sections And Inserts Are To The Scale As Shown on Section D-D

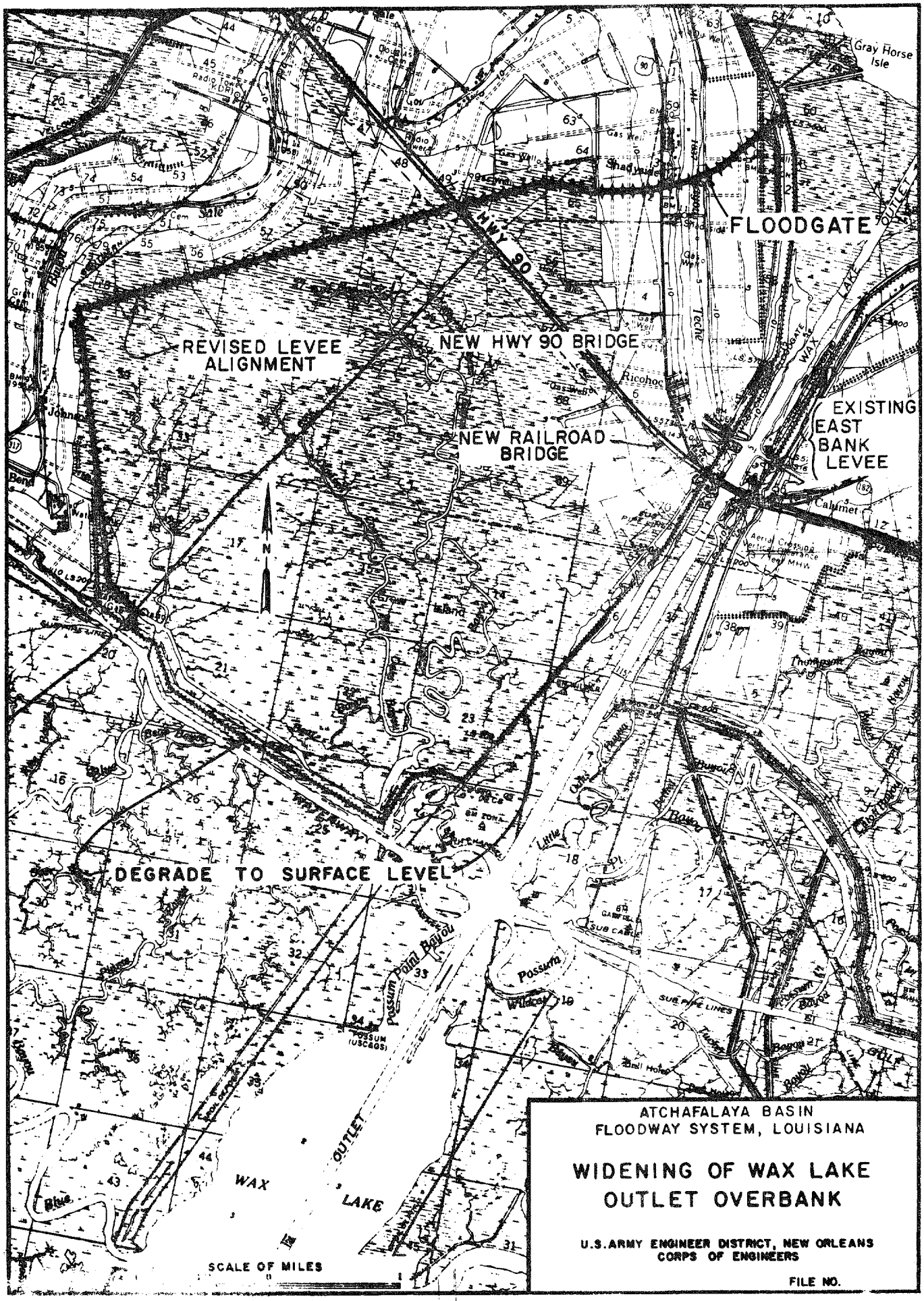
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

WAX LAKE STRUCTURE & LEVEE
70 % LAR – 30 % WLO

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-10



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

WIDENING OF WAX LAKE OUTLET OVERBANK

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-11

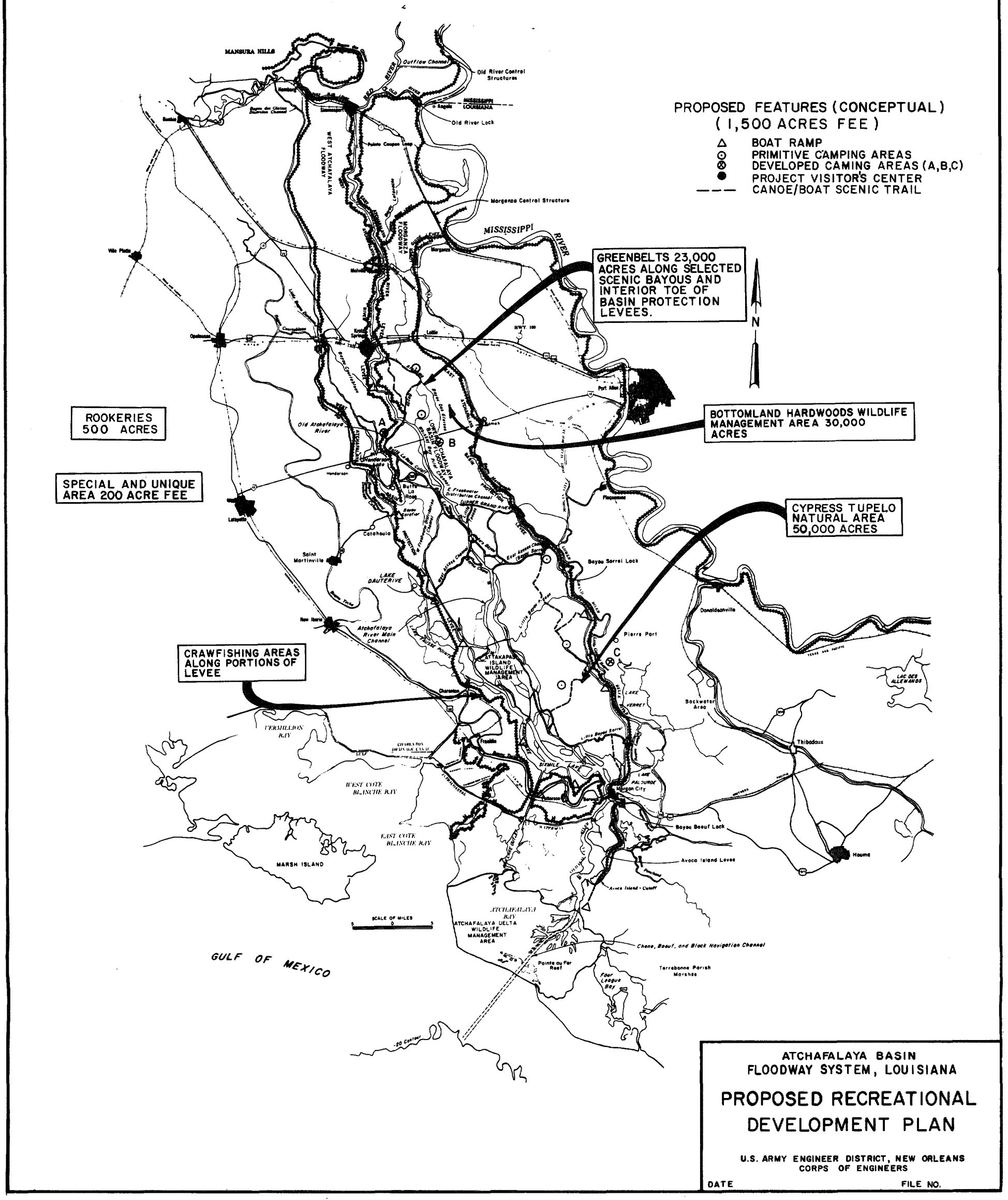


PLATE B-12

PLATE B-12

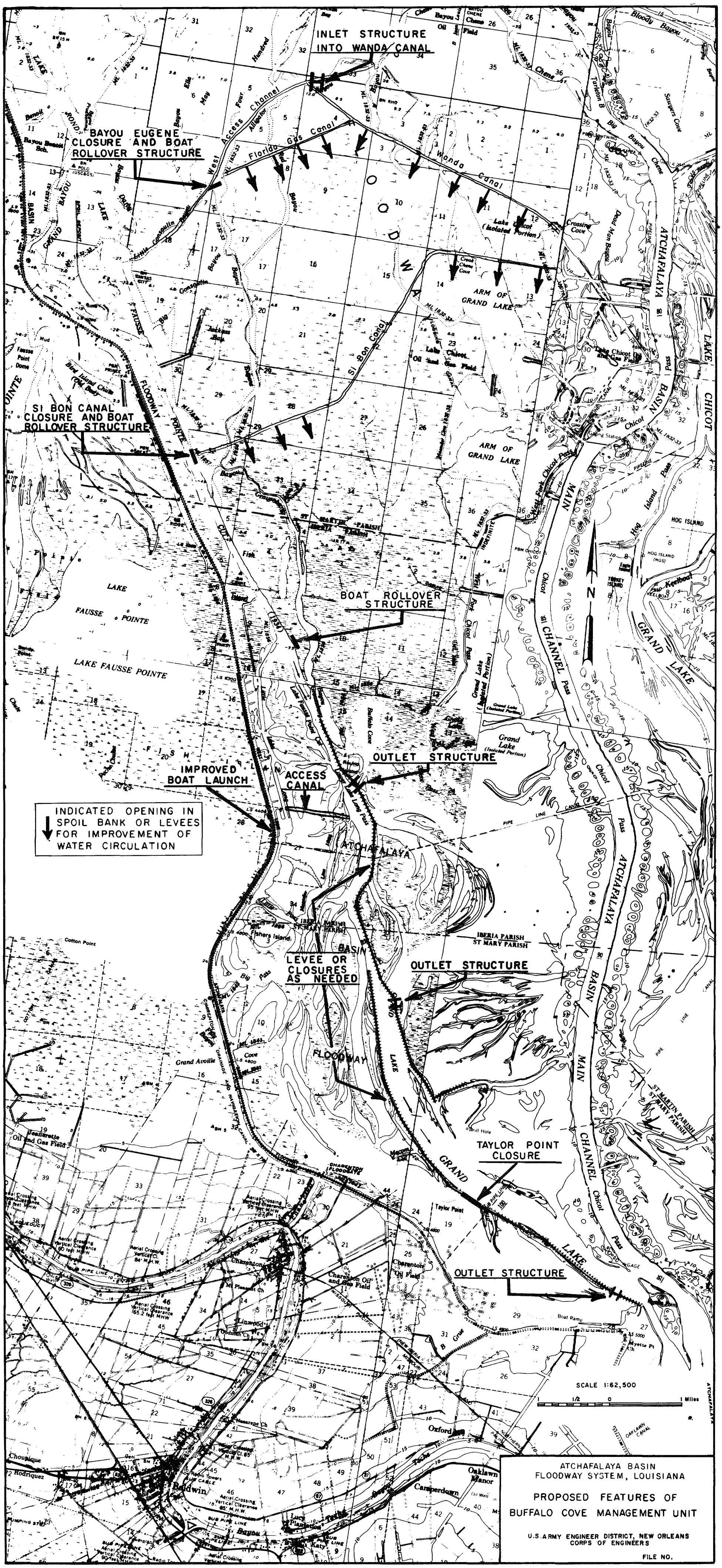
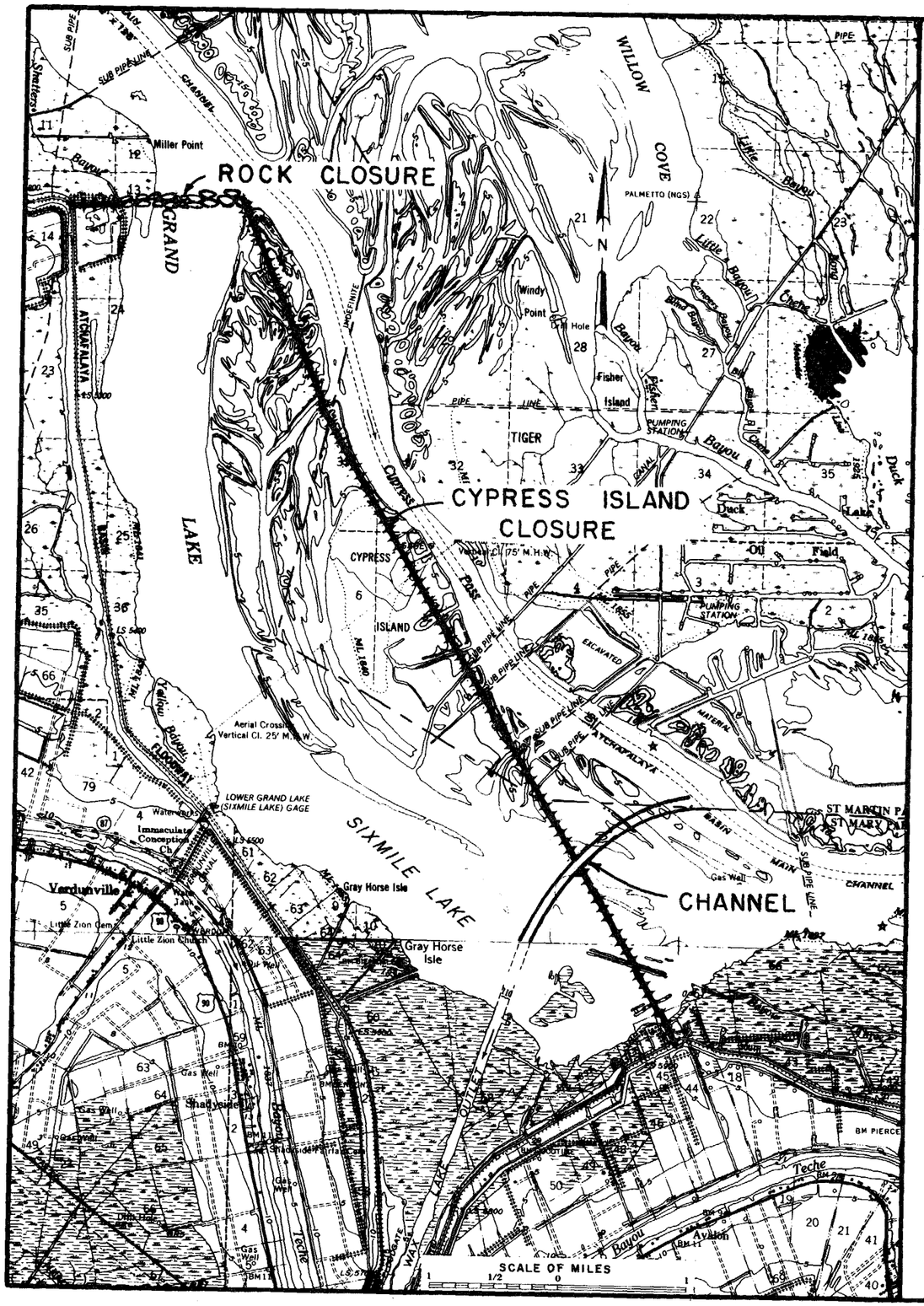
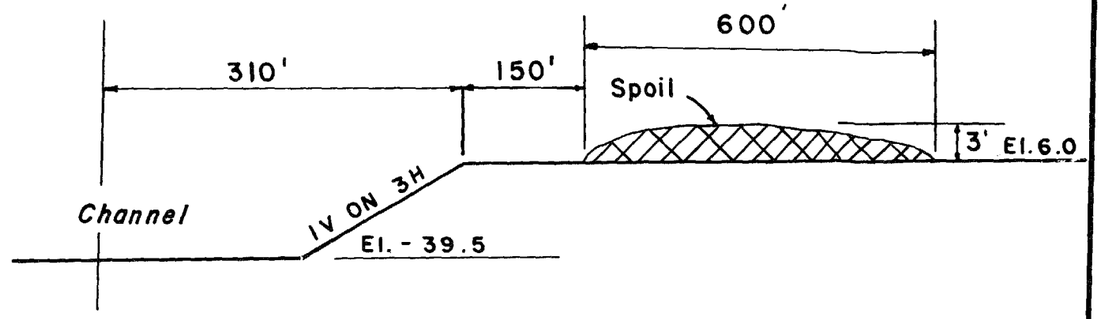

INLET STRUCTURE INTO WANDA CANAL
BAYOU EUGENE CLOSURE AND BOAT ROLLOVER STRUCTURE
SI BON CANAL CLOSURE AND BOAT ROLLOVER STRUCTURE
BOAT ROLLOVER STRUCTURE
OUTLET STRUCTURE
IMPROVED BOAT LAUNCH
ACCESS CANAL
OUTLET STRUCTURE
LEVEE OR CLOSURES AS NEEDED
FLOODWAY
TAYLOR POINT CLOSURE
OUTLET STRUCTURE
INDICATED OPENING IN SPOIL BANK OR LEVEES FOR IMPROVEMENT OF WATER CIRCULATION
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
PROPOSED FEATURES OF BUFFALO COVE MANAGEMENT UNIT
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
FILE NO.
SCALE 1:62,500
1 1/2 0 1 Miles
PLATE B-13

PLATE B-13



TYPICAL SECTION

NOT TO SCALE



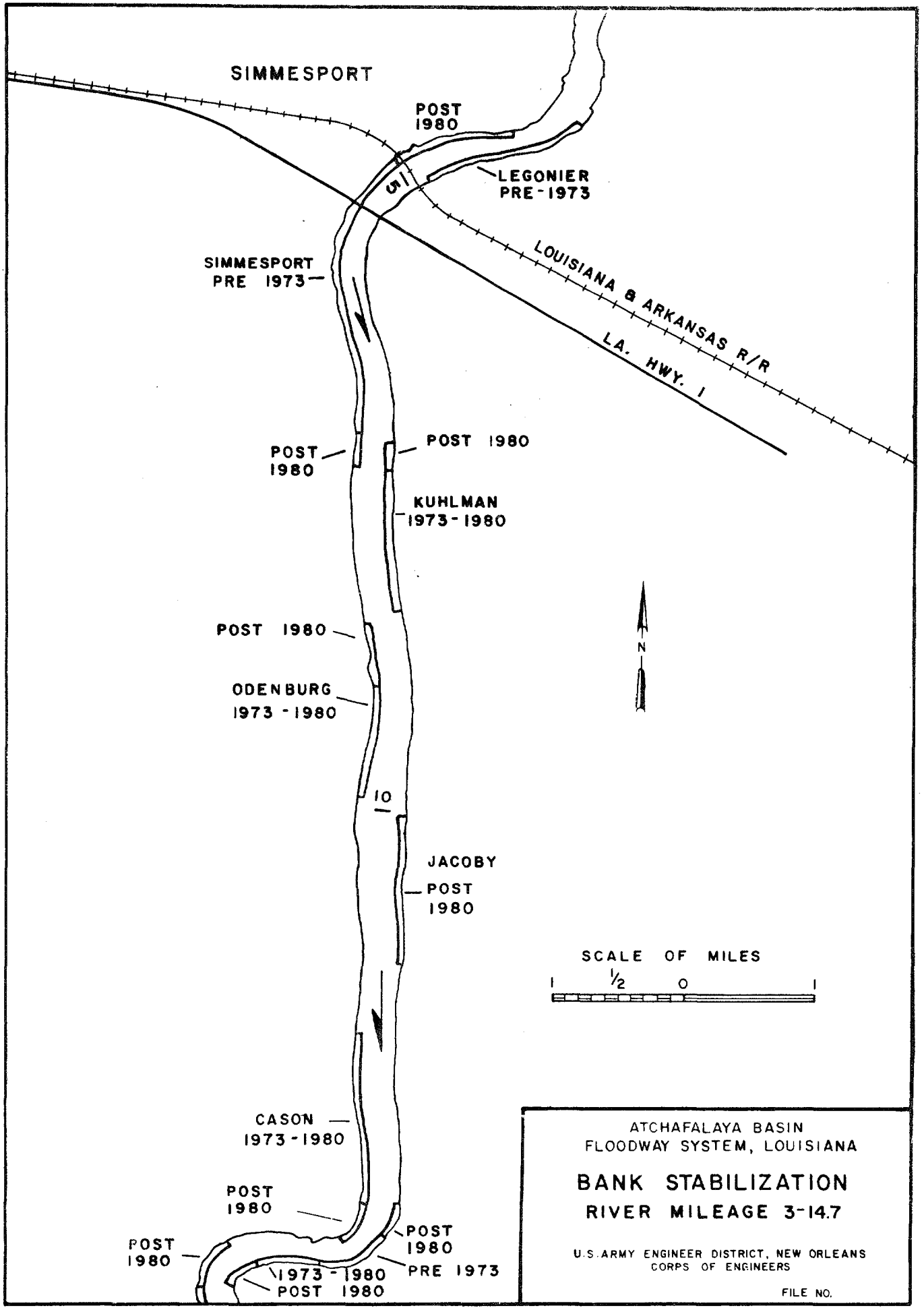
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

INCREASED SEDIMENT THROUGH WAX LAKE OUTLET

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-14



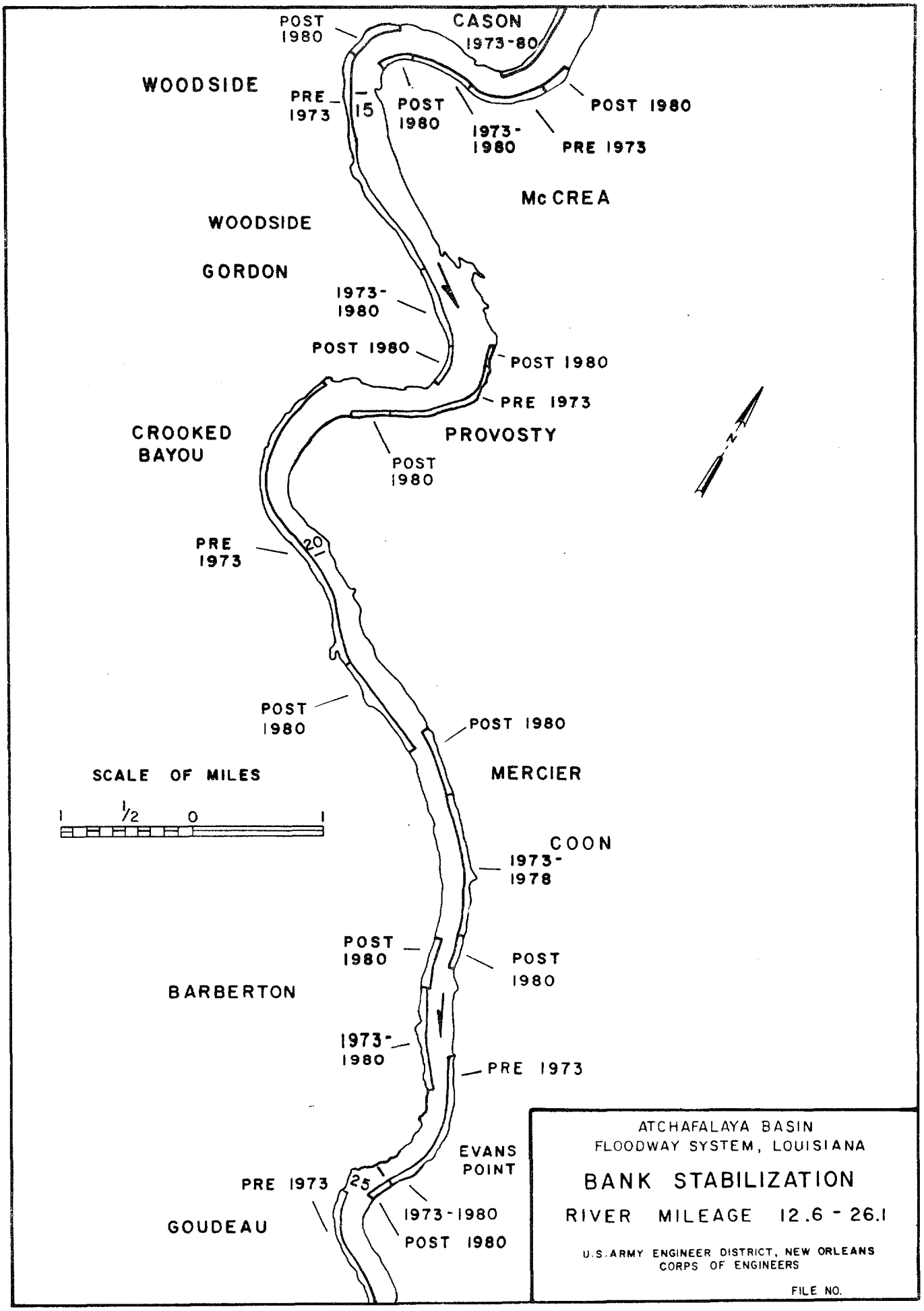
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BANK STABILIZATION
RIVER MILEAGE 3-14.7

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-15



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

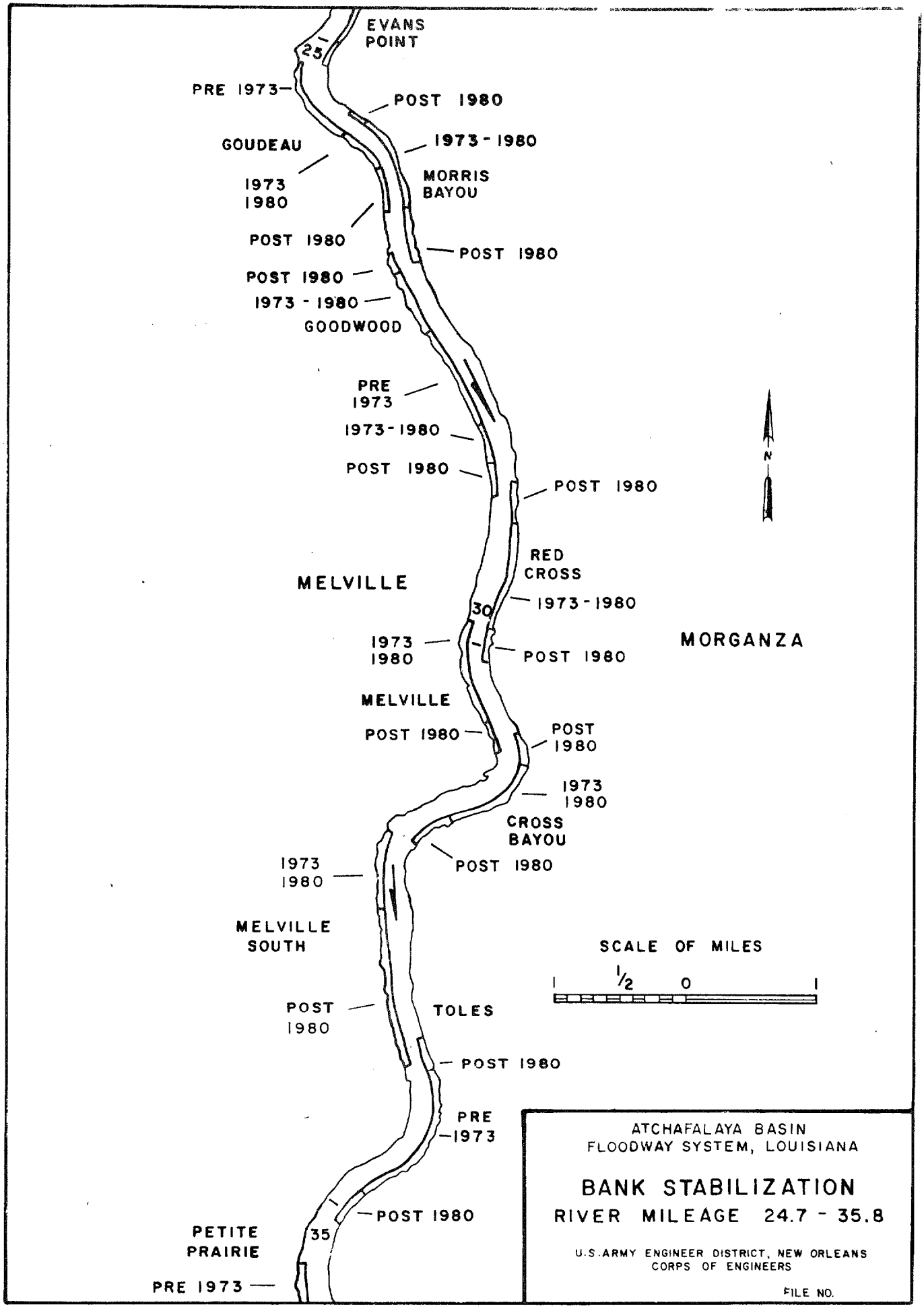
BANK STABILIZATION

RIVER MILEAGE 12.6 - 26.1

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-16



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BANK STABILIZATION

RIVER MILEAGE 24.7 - 35.8

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-17

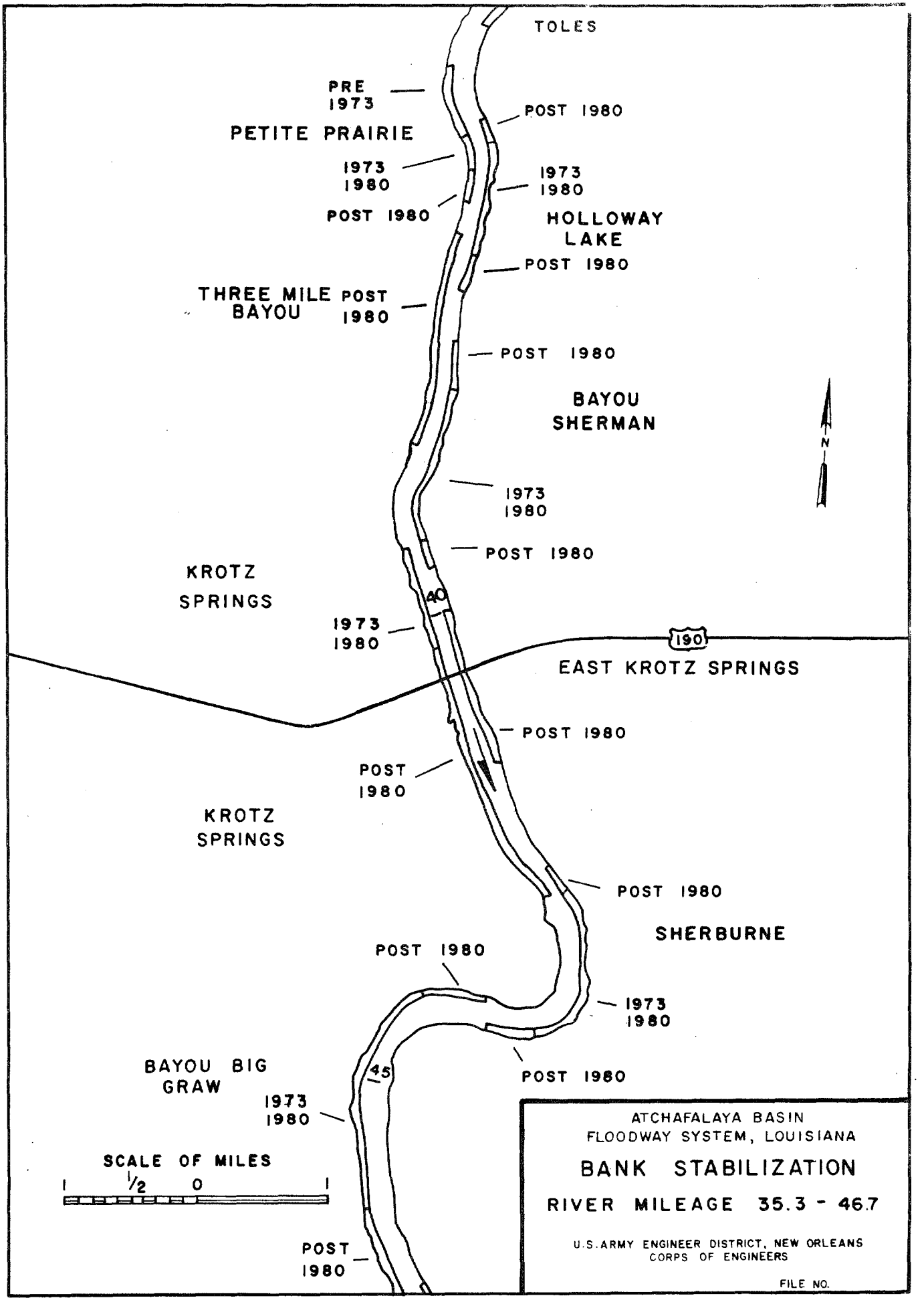
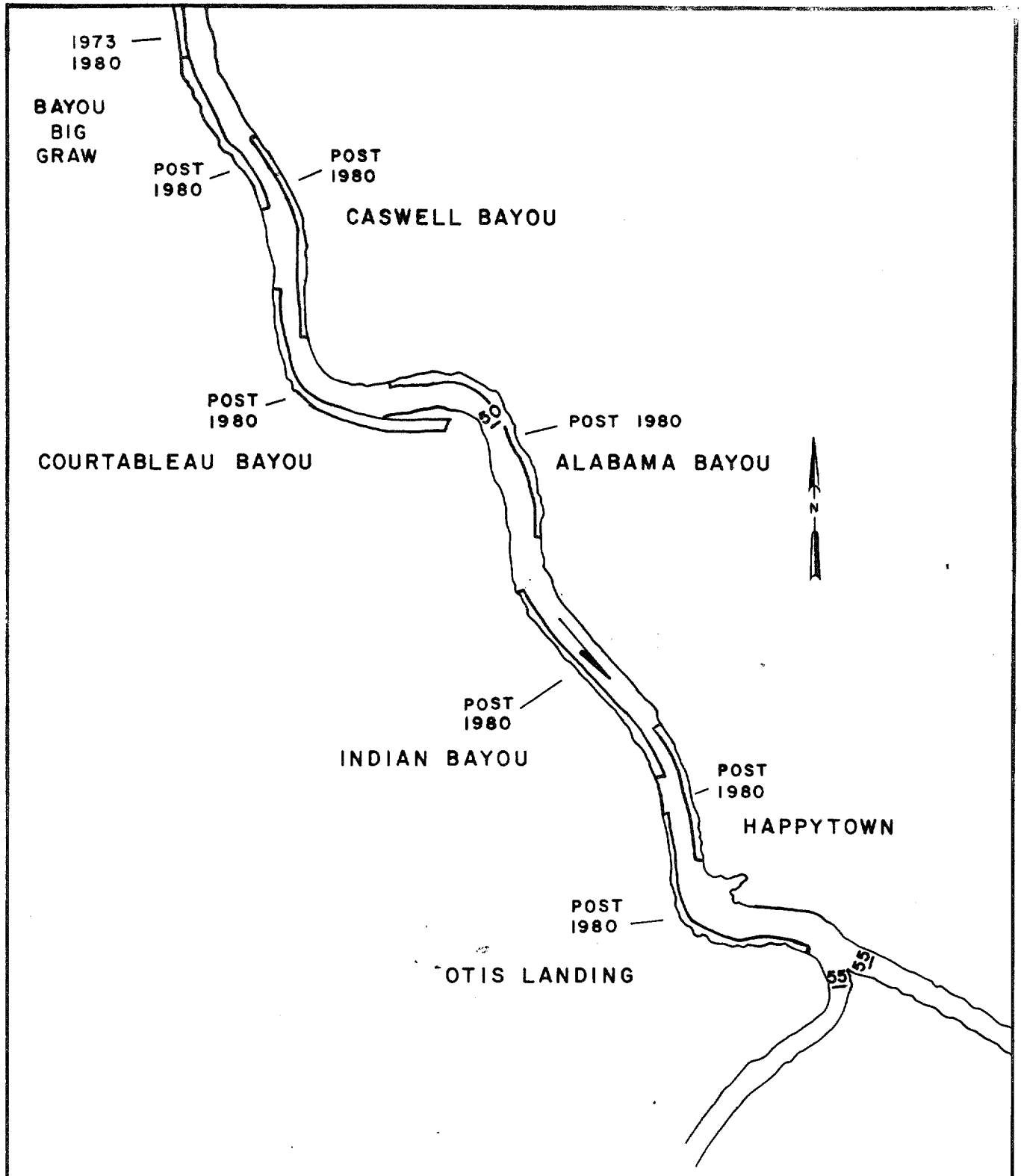

TOLES
PRE 1973
POST 1980
PETITE PRAIRIE
1973 1980
POST 1980
1973 1980
HOLLOWAY LAKE
POST 1980
THREE MILE BAYOU
POST 1980
POST 1980
BAYOU SHERMAN
N
1973 1980
POST 1980
KROTZ SPRINGS
40
1973 1980
190
EAST KROTZ SPRINGS
POST 1980
POST 1980
KROTZ SPRINGS
POST 1980
SHERBURNE
POST 1980
1973 1980
BAYOU BIG GRAW
45
1973 1980
POST 1980
SCALE OF MILES
1/2 0
POST 1980
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 35.3 - 46.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE B-18



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

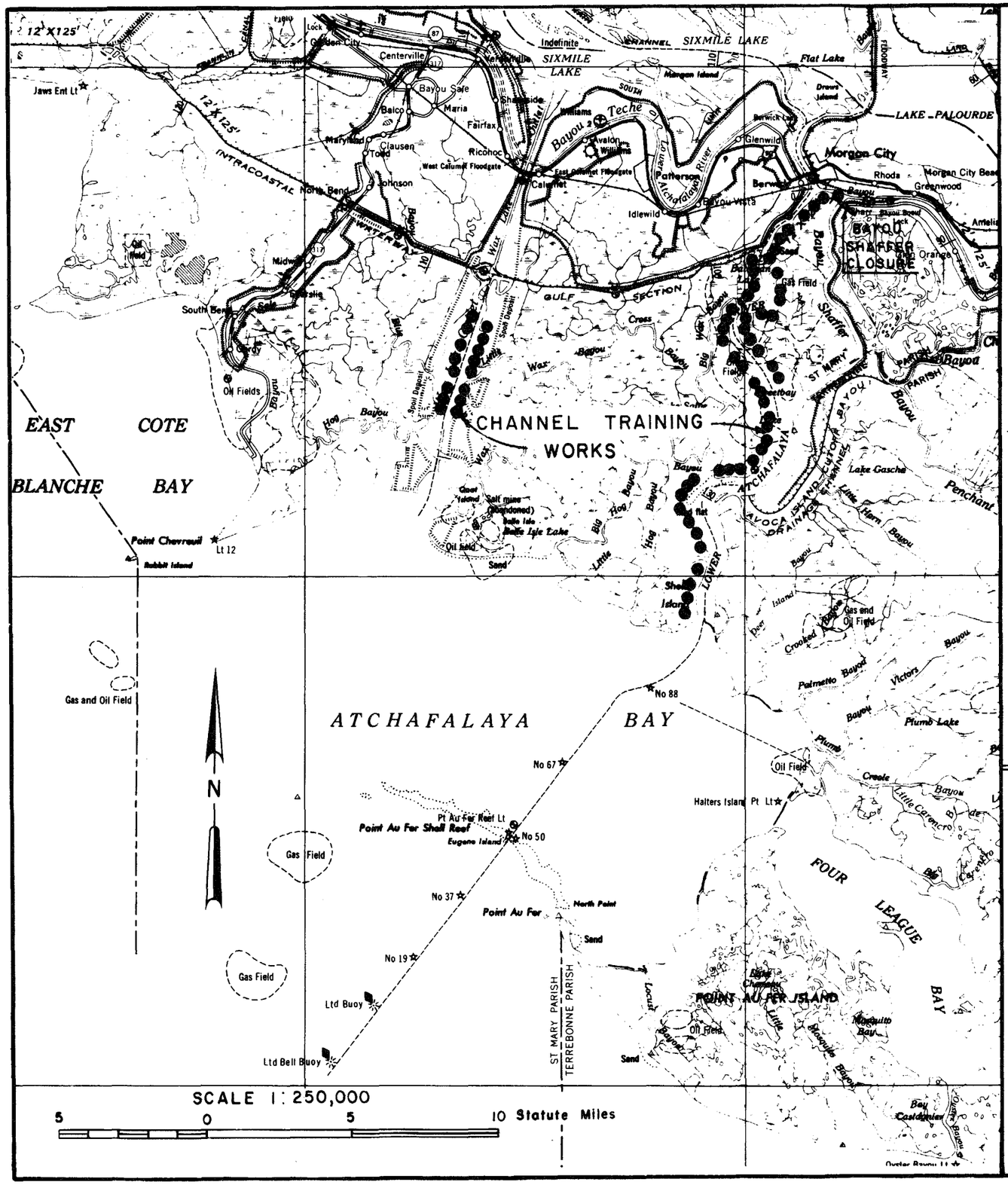
BANK STABILIZATION

RIVER MILEAGE 46.2 - 55

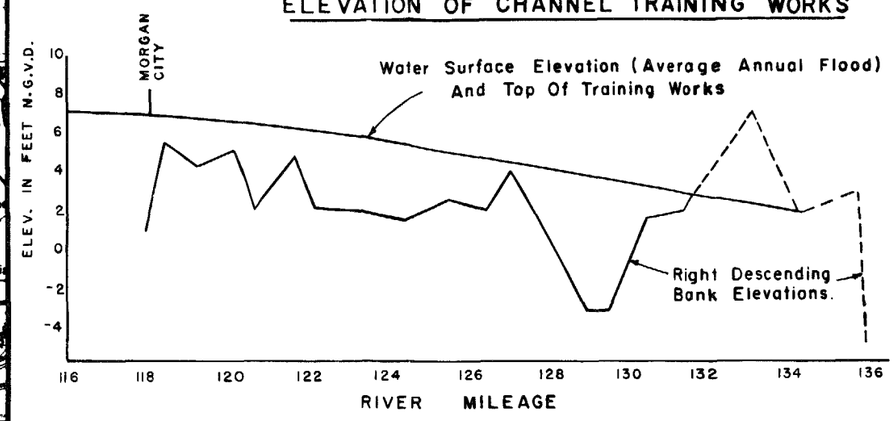
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

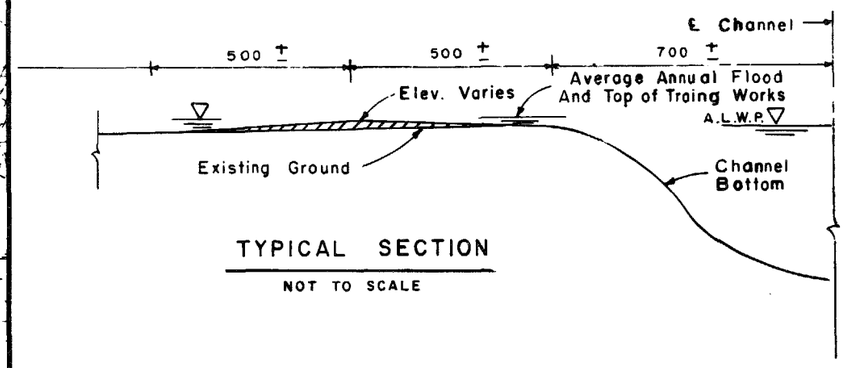
FILE NO

PLATE B-19



ELEVATION OF CHANNEL TRAINING WORKS





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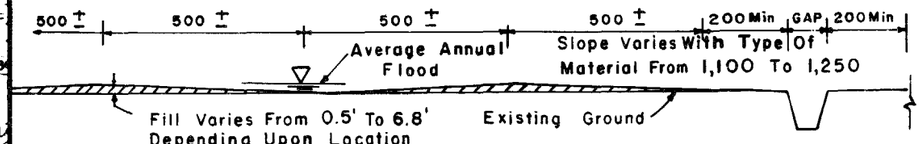
NOT TO SCALE



TYPICAL PROFILE

NOT TO SCALE

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

LOWER ATCHAFALAYA RIVER AND WAX LAKE OUTLET CHANNEL TRAINING

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-20

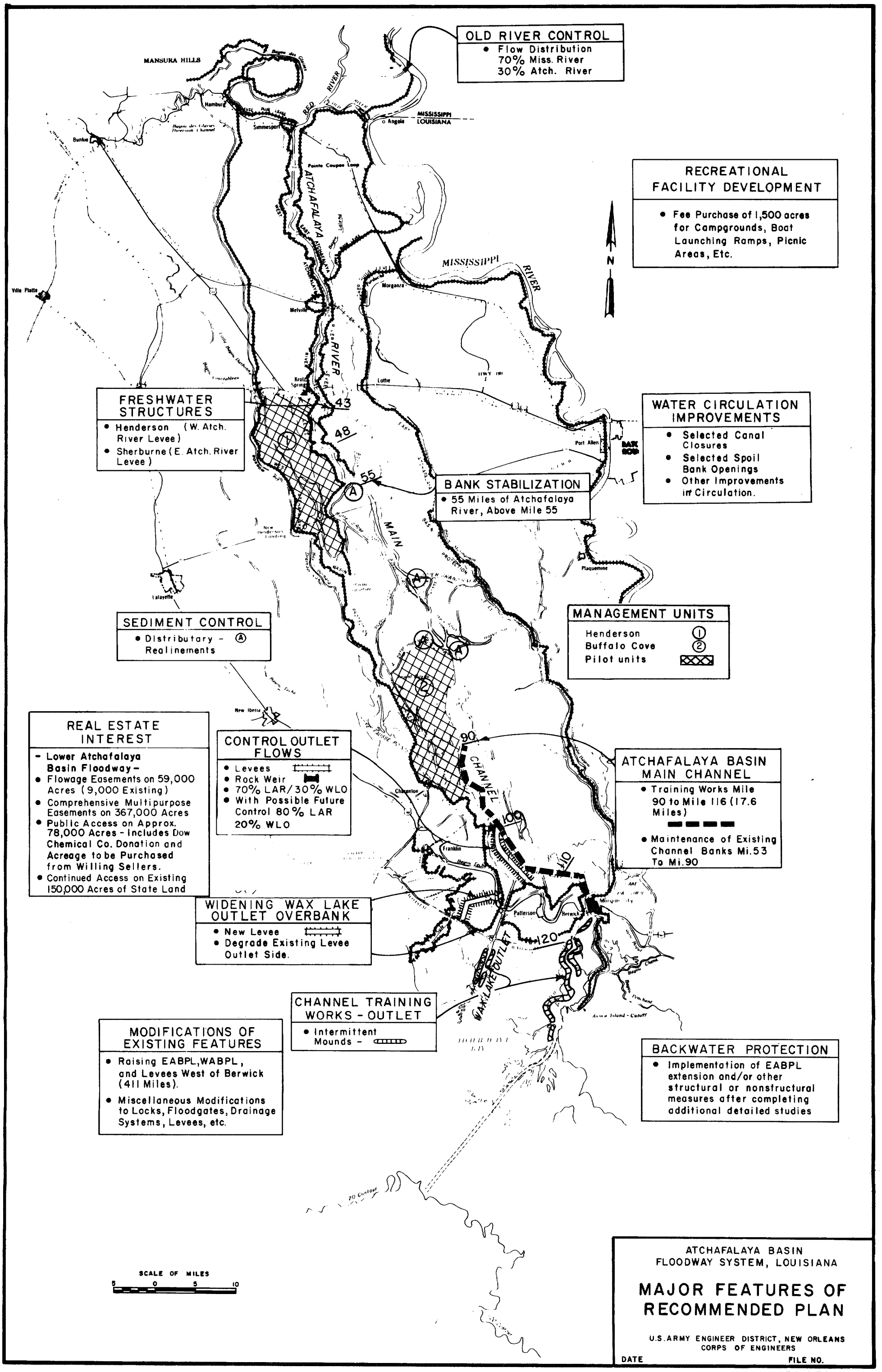


PLATE B-21

PLATE B-21

APPENDIX C

ENGINEERING INVESTIGATIONS

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Appendix C

ENGINEERING INVESTIGATIONS

C.0.1. The scope of the investigations included in this report is considered adequate to compare various alternatives and to be used as a basis for further design. An historic description of the basin and a review of the present status of the project are contained in Appendix A. The discussions in the following sections offer details that explain the engineering investigations. Geographic locations referenced in this report can be found on Plate 1 of the main report.

Section 1 - EVALUATION PROCEDURE

GENERAL

C.1.1 Hydraulic and hydrologic investigations for the Atchafalaya Basin Study developed data to specifically address flood control in the basin, while other data were developed to address environmental concerns for a given alternative. The following paragraphs describe each category of information, how it was developed, and why it was required.

CHANNEL DEVELOPMENT CURVES

C.1.2. The connection between the Atchafalaya River and the Mississippi River was formed in the sixteenth century when a migrating meander of the Mississippi River intercepted the course of the Red River. In 1831, Captain Shreve cut off the meander to shortern the distance of the Mississippi River for improved navigation. Removal of the 20-mile-long driftwood raft in the Atchafalaya River in 1855 resulted in improved navigation in the Atchafalaya. As a consequence of siltation induced by the cut off and removal of the raft, the Red River altered its course to flow directly into the Atchafalaya River. Therefore, the Atchafalaya River gradually claimed increasing shares of the flows from the Mississippi and Red Rivers. The gradual increase of flow into the Atchafalaya River was accompanied by steady increases in cross-sectional area.

C.1.3. Cross-sectional area of the Atchafalaya River is measured in square feet (sf) below the 1963 reference flowline, which results in channel area below a fixed datum plane. The fixed datum plane was used to facilitate comparison of hydrographic surveys. The change in channel area for the fixed datum plane represents a change in the channel geometry and is not necessarily directly related to a change in the wetted area of the stream for a given basin discharge, since a change in channel area is accompanied by a change in the actual flowline.

C.1.4. Hydrographic surveys of the channel have been taken since the late 1800's. The areas for several cross sections spread over a few miles are averaged for each survey to give the average area for a reach. The areas for several reaches are averaged to give the average channel area for mile 0-54.8[1/] (leveed reaches), mile 54.8-65.4

[1/] All mileage is referenced to 1950 mileage unless otherwise noted.

(Whiskey Bay Pilot Channel), mile 65.4-100.8 (distributary reaches), mile 100.8-113.7 (lake area), mile 105.5-124.0 (Wax Lake Outlet), and mile 113.7-136.8 (Lower Atchafalaya River). The channel development curves for each section of the river are plotted as channel area versus the year of the survey (Plates C-1 through C-8).

C.1.5. Since the removal of the rafts in the Atchafalaya River, the cross-sectional area of the Atchafalaya River has continued to increase; the lakes in the lower part of the basin have filled with sediments; and the development of a main channel through the lakes has taken place. Dredging of the main channel from 1955 to 1968 was for the purpose of accelerating the development of this channel. Concurrent with the dredging program, closure of 22 distributaries was accomplished to confine a larger percent of the flow to the main channel which, in turn, accelerated the natural erosive action of the river to establish a larger main channel. As shown on Plates C-1 through C-8 the area of the river has progressed to approximately 118,000 sf from mile 0 to mile 54.8; to 92,000 sf from mile 54.8 to 65.4; to 80,000 sf from mile 65.4 to 100.8 and to 38,000 sf from mile 100.8 to 113.7. The area of the Lower Atchafalaya River (mile 113.7-136.8) had decreased to about 69,000 sf. This was primarily due to the loss of flow to the Wax Lake Outlet, which has increased its area to 38,000 sf.

C.1.6. Channel development curves give a graphic representation of channel geometry changes. The projections of the channel area shown on the curves were also used in the HEC-2 computer model, which is described later, to determine the effects channel development will have on average hydrographs in each management unit and on the project flood flowlines.

C.1.7. Projections of future channel development were based upon projections of changes in flow distribution and results of the computer model HEC-6, Scour and Deposition in Rivers and Reservoirs.

AREA - ELEVATION CURVES

C.1.8. The Atchafalaya Basin, as a riverine swamp, has been subject to yearly overflows of the Atchafalaya River. Along with the vast quantities of water overflowing the banks of the river, there have been equally large quantities of sediments. The lower basin was once characterized by the open bodies of water of Grand and Sixmile Lakes, but the sediments of the Atchafalaya have now filled these lakes. The overbank marsh areas have also received large quantities of sediments, causing some to become dry ground for most of the year. This process of a river overflowing its banks and depositing sediments in the adjacent areas is a natural process of a young developing river such as the Atchafalaya. Each year as the river conveys the springs floods to the gulf, it will overflow its banks and continue to deposit

sediments in the overbank areas. Deposition of these sediments deprives the floodway of some of the overbank area that should convey about two-thirds of the project flood.

C.1.9. Hydrographic surveys have been taken regularly since the late 1800's on the 30 cross-basin ranges located in the floodway. These surveys are used to monitor deposition rates. Five-foot contour lines were drawn from the 1974 survey to establish present conditions. From these contours the area-elevation curves were drawn to represent the area of land below a given elevation (Plates C-9 through C-23).

C.1.10. Future contour lines and area-elevation curves for the no-action alternative were drawn, based on past deposition rates, expected flowline changes, and changes in the distribution of flow within the basin. Area-elevation curves for various alternatives were drawn to illustrate what effect each alternative would have on the overbank deposition.

C.1.11. Area-elevation curves were drawn for each of the management unit areas (Figure C-1-1) and for the backwater area east of Morgan City. The latter area was divided into four subareas (Plate C-48) for which the present curves were assumed to be applicable to future conditions, since the region is not subject to sediment deposition.

C.1.12. The area-elevation curves were divided into habitat types to evaluate land-use projection. This division of the curves is discussed in Appendix G. The area-elevation curves also represent the overbank deposition that was used in the HEC-2 computer program to determine deposition effects on average hydrographs and project flowlines.

STAGE - DISCHARGE RELATIONSHIPS

C.1.13. Discharge observations have been made regularly on the Atchafalaya River at Simmesport, Louisiana, since 1928. Except for local rainfall or during operation of the Morganza Floodway or West Atchafalaya Floodway, the Simmesport discharge represents the total flow in the Atchafalaya Basin Floodway. Annual sediment and discharge values for Simmesport are presented in Appendix A. While discharge measurements are made in the Lower Atchafalaya River at Morgan City and Wax Lake Outlet at Calumet, these are not rated stations and were only used to define the distribution of flow at the outlets. Water and sediment discharge measurements were also made in the east and west access channels and east and west freshwater distribution channels to identify the water and sediment being conveyed from the main channel. Additional discharge measurements are made at discharge ranges throughout the floodway during distribution of flow measurements (Plate C-24). There have been 18 of these surveys since

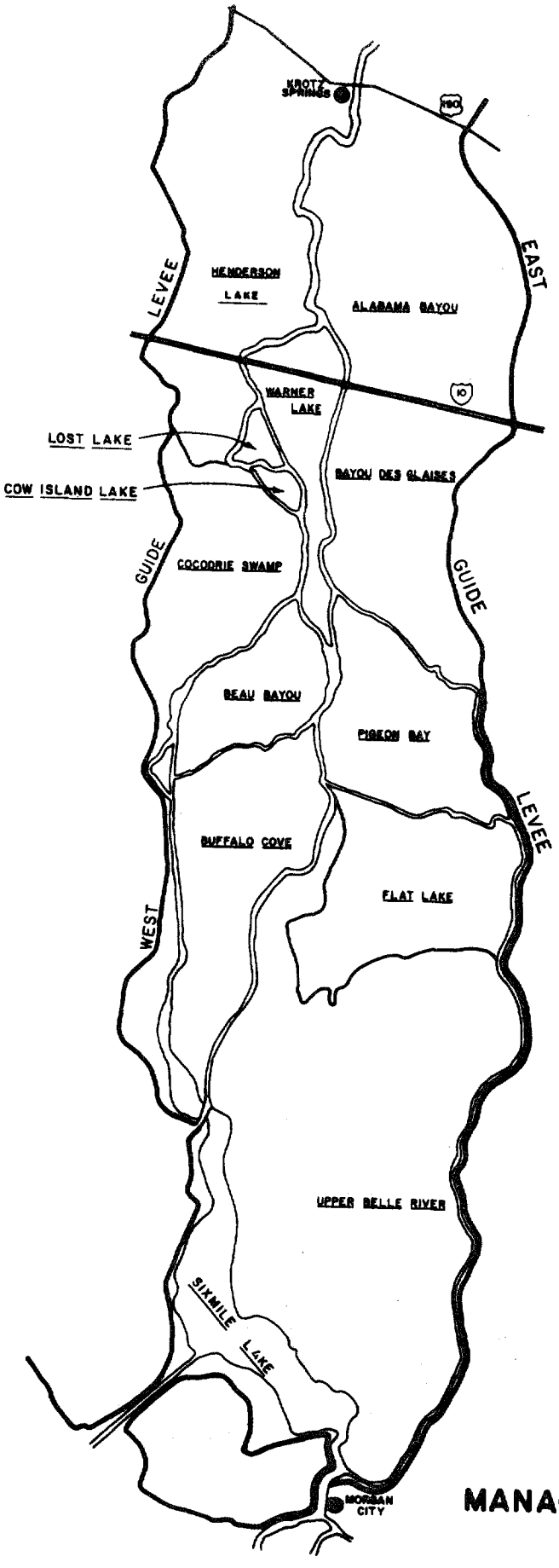


FIGURE C-1-1

MANAGEMENT UNITS

1955, and they were used to identify the distribution of flow shown on Plate C-25.

C.1.14. Stage indicators are located throughout the floodway. These gaging stations have records that have been maintained from 4 to 100 years.

C.1.15. Stage discharge relationships were developed for stages at each of the gaging stations and discharges at Simmesport. These relationships became the base for average stage hydrographs, with or without management units. The relationships were further supplemented by data obtained from the Mississippi Basin Model (MBM) at Waterways Experiment Station (WES), which will be discussed later. Projections of future stage discharge relationships were based on the HEC-2 and HEC-6 computer runs, discussed in subsequent paragraphs.

MODEL STUDIES

C.1.16. MBM. The MBM is a fixed bed model located in Jackson, Mississippi, and operated by WES in Vicksburg, Mississippi. The model has a 1:100 vertical scale and 1:2000 horizontal scale. The portion of the model used in this study extends from Simmesport to Eugene Island in the Atchafalaya Bay and includes the West Atchafalaya Floodway and the Morganza Floodway. The discharge enters the model at Simmesport and the West Atchafalaya and Morganza Floodways when appropriate. Elevations at Eugene Island are controlled by an overflow weir. The model is capable of simulating steady-state discharges and discharge hydrographs. The model has been molded to 1973-1974 survey conditions and calibrated to the 1973 hydrograph.

C.1.17. Gages were placed in the model at prototype gage locations and in the center of each management unit area (Plate C-26). The gages in the center of the units are the basis for stage relationships between the center of a unit and the river at the unit's inlet. Data obtained from hydrograph runs and steady flow runs were used to develop these relationships. The loop effect (stages for a given discharge are higher on the falling side of the hydrograph than on the rising side), which is prevalent in this area, has been averaged out.

C.1.18. Data were obtained from model runs using the average hydrograph, shifted average hydrograph, and constant discharges of 50,000, 100,000, 200,000, 350,000, 425,000, 600,000, and 800,000 cubic feet per second (cfs). Additional tests using hydrographs and steady discharges were run with Wax Lake Outlet closed, with channel training works in place, and with the Buffalo Cove management unit in place. In addition to stage data, information was obtained from these runs of flow patterns in the Atchafalaya Bay. The results of all tests are presented in MBM Report 31-8, "Effects of Closing Wax Lake

Outlet and Constructing Management Unit and Channel Training Levees in the Atchafalaya Basin," November 1980.

C.1.19. HEC-2. Flowlines (water surface profiles) for various flows, including the project flood, were computed using HEC-2, "Water Surface Profiles," a computer program developed by the Hydrologic Engineering Center (HEC) in Davis, California. The program computes backwater profiles by the standard step method.

C.1.20. The channel cross sections used in the HEC-2 model were established from 1973 element surveys located no more than 1.5 miles apart. The overbank sections within the floodway were established from sedimentation ranges dated 1966-1973. Because of the accretion occurring in the lower basin, aerial reconnaissance trips were made and overbank sections were modified, as necessary, to accommodate changes in features, such as, filling of lakes and closure of distributary channels.

C.1.21. Calibration of the analytical model was accomplished using observed flowlines from stage and discharge records obtained during the 1973 flood. To reduce possible errors, which could be generated by storage and momentum effects, periods of relatively constant stage and discharge ranging from 5 to 10 days were chosen for flowline calibration. Details of the calibration, including observed and computed flowlines, can be found in "MR&T Project Flood Flowline Review Report," dated December 1976, revised September 1977. Projected changes in channel development and overbank deposition were incorporated into the model to develop flowlines for various alternatives. Flowlines for discharges of 50,000, 100,000, 250,000, 350,000, and 450,000 cfs were computed for the alternative plans. Comparisons of the flowline conditions were used to modify the stage-discharge relationships for each of the management unit areas to obtain the future rating curves of the units.

C.1.22. Project flood flowlines for each alternative plan were computed with the HEC-2 model. This will be discussed in detail subsequently in this report.

C.1.23. HEC-6. Projections of future channel development were supplemented by runs of the computer program HEC-6, "Scour and Deposition in Rivers and Reservoirs." The program is a one-dimensional steady flow model designed to analyze scour and deposition by modeling the interaction between the water-sediment mixture, sediment material forming the stream's boundary, and the hydraulics of flow. The model cannot simulate the development of meanders or specify a lateral distribution of sediment load across a cross section.

C.1.24. A special version of HEC-6 was used in this study. The "strip model" enabled the basin to be divided into six strips, each containing portions of the basin with similar hydraulic and sediment

carrying characteristics. Strip 1 consisted of Lake Long, Lake Fausse Pointe Cut, and Grand Lake, and contained characteristics (Manning's "n", scour, and deposition capabilities), which would be experienced by a channel. Strip 2 modeled the overbank area west of the main channel and contained characteristics of an overbank flow regime. The main channel throughout the floodway was modeled in strip 3. Because of its large transport capacity during high discharges, Grand Lake east of the main channel was modeled with channel characteristics during high flows in strip 4. Strip 5 contained overbank characteristics for the overbank area east of the main channel. Upper Grand River and the alternate route of the intracoastal waterway were modeled with channel characteristics in strip 6. In parts of the basin where the area represented by a strip merged with the main channel, such as, Lower Atchafalaya River at Morgan City, the strip was reduced to a width of 1 foot and therefore, became ineffective.

C.1.25. The geometry used in the HEC-6 model is basically the same geometry developed for the HEC-2 model. A description of its derivation is contained in the previous section of this appendix. Modification of the HEC-2 data consisted of elimination of some cross sections so that they were located at about 1-mile intervals. This reduction in the number of cross sections permitted a single HEC-6 model from mile 0 on the Atchafalaya River to mile 146 on the Lower Atchafalaya River. The program did not model Wax Lake Outlet, Morganza Floodway, or the West Atchafalaya Floodway directy, but did account for them by the proper introduction or reduction of flow at their locations. The inflowing sediment rating curve used in the program was the average rating curve at Simmesport for the period 1971-1975. Bed gradations were derived from sampling of the river bed at 5-mile intervals in 1975.

C.1.26. Calibration of the model was made to observed water surface elevations, observed distribution of flow, and observed sediment loads at Morgan City. The proper distribution of flow between strips was determined from observed distribution of flow in the basin and from observations of the MBM (both discussed previously).

C.1.27. Hydrographs used in simulation runs consisted of Simmesport discharge hydrographs modified to reflect a 30-percent latitude flow at Old River. Changes in the percent diverted through Wax Lake Outlet enabled the model to simulate the effects different outlet distributions would have on channel development.

C.1.28. Comparisons of channel development from the simulation runs were used as input to generating channel development curves. Since the HEC-6 program did not model silt and clay transport and is a one-dimensional model, it is not appropriate to use its results as definitive answers, but one can use HEC-6 as a tool to compare two alternatives.

AVERAGE HYDROGRAPHS

C.1.29. Without Management Units. The aquatic nature of the Atchafalaya Basin Floodway is measured by the extent and duration of normal overbank flooding. To describe this aquatic nature and determine the effects various alternatives would have on it, average hydrographs were developed. Since during the average year, neither Morganza nor the West Atchafalaya Floodways are operating, the Simmesport discharge represents the total flow in the Atchafalaya Basin Floodway. Development of the average discharge hydrograph for the Atchafalaya River at Simmesport was the key to describing average stage hydrographs, since, as discussed previously, the stages in all parts of the floodway were related to the Simmesport discharge.

C.1.30. Daily discharges have been computed for the latitude of flow below Old River since 1949. Thirty percent of the latitude discharge for the period 1949-1978, was used to compute the average hydrograph by averaging the discharge values for each day for all the years.

C.1.31. The total flow for the average annual hydrograph was equal to the average annual total flow for the 30 years, but the shape of the average hydrograph did not represent the general shape of an observed hydrograph. This is exemplified by the peak discharge of the average annual hydrograph about 100,000 cfs less than the average annual peak for the 30 years. The peak of the average hydrograph is less than the average annual peak because the peak of each year occurred over a large time frame and not on a common day. Use of this hydrograph would result in considerably lower peak stages throughout the floodway; therefore, the area of land inundated during the average hydrograph would be far less than that inundated during the average year.

C.1.32. To rectify this, the average annual shifted hydrograph was computed by shifting each hydrograph so that it would peak on 15 April (the day the average hydrograph peaked). Since the peak discharge in a year did occur up to 62 days from April 15, water-year hydrographs (October-September) were used for this computation. Those days pushed off one end of the hydrograh because of the shift were moved to the vacant days on the other side of the hydrograph. While this exchange of days did in some instances leave a discontinuity in a hydrograph, it was found to be of little significance because of its location in the hydrograph (during low flows when all values averaged are generally the same). After shifting each hydrograph, the discharge value for each day was averaged with the value for its corresponding day for each year. The result of this procedure was an average shifted hydrograph with its peak equal to the average annual peak, and with its total volume equal to the average annual total flow for the 30 years. As shown on Plate C-27, the average shifted hydrograph not only has a higher peak but has a steeper rise and fall than the average annual hydrograph, being more representative of a typical hydrograph.

C.1.33. From this average shifted hydrograph and the rating curves discussed previously, stage hydrographs were developed for each management unit area (Plate C-28 through C-36). These stage hydrographs were developed for existing conditions and for future conditions for various alternatives.

C.1.34. With Management Units in Place. It was necessary to develop stage hydrographs with management units (Figure C-1-1) in place in a different manner, since construction of the management units would change the hydrologic relationship of the overbank area to the main channel. Construction of management units consists of building a levee around the area up to an elevation equal to the average annual peak flowline. Inlets and outlets to the units were located to increase circulation through the units. In most instances, this called for the introduction of water to the unit at a higher level than existing conditions. For these reasons, the relationships of stage to Simmesport discharge had to be modified.

C.1.35. A computer program was used to develop the average stage hydrographs for conditions with management units in place. The program treated the management unit as a reservoir, and the level-pool flood routing method was utilized to route the inflow hydrograph through the unit. Input data to the program consisted of: the daily dicharges for the average shifted hydrograph; polynomial equations fitted to the stage-storage curve for the unit, stage-discharge curve at the inlet, and stage-discharge curve at the outlet; and the type and physical dimensions of the inlet and outlet of the unit.

C.1.36. The program begins its calculations by computing the stage at the inlet from the given Simmesport discharge and the equation for the stage-discharge relationship at the inlet. With this stage and the appropriate formula for the type of inlet structure, the flow into the unit was calculated. The inflow volume for the day was computed and added to the existing storage in the management unit. The stage associated with that storage volume was calculated by means of the equation fitted to the stage-storage curve, and the stage at the outlet is calculated by means of the equation at the outlet. The outflow was calculated by the appropriate formula, according to the type of structure at the outlet. The procedure was repeated for each day of the average hydrograph. Before printing the results, the program employed the method of moving averages to smooth out irregularities.

C.1.37. The program was capable of computing flow for the inlets and outlets, consisting of a broad-crested weir, box culvert, or an open channel. In all cases used for this study, except for Henderson and Alabama Bayous, the inlets and outlets were uncontrolled; therefore, water could flow in either direction. For example, flow out the inlet usually occurred during the falling side of the hydrograph when a small outlet was restricting flow and the stage in the management unit exceeded the stage in the river at the inlet.

C.1.38. Design of the inlets and outlets of the management units had the objective of duplicating the desired stage hydrograph for that management unit. Development of the desired hydrograph is discussed in Appendix G. Since the inlets and outlets of the units were uncontrolled weirs, except for Henderson and Alabama Bayous, the stage in the unit generally fluctuated with the stage of the river, but minor control of the stage could be achieved by varying the size of the inlet in both length and height.

C.1.39. The design of the Buffalo Cove inlets and outlets also gave consideration to minimizing the sediment entering the unit by minimizing the volume of water entering while still approximating the desired hydrograph. The result of the design (Plate C-37) is one or more inlets totaling 400 feet in length and a sill elevation of 7.0 National Geodetic Vertical Datum (NGVD).[2/] The outlet weir has a 40-foot length and a sill elevation of 3.5. The model runs did indicate that this inlet and outlet could reduce the quantity of water and thus sediment diverted into the unit during the average hydrograph by about 50 percent; however, because of slower velocities through the unit, the trap efficiency was greater than for existing conditions. Because of the uncertainty of the trap efficiency of a unit, the ineffectiveness of a unit during higher than average hydrograph flows, and the uncertainty of how much of the confining levees will be initially constructed, the effects of the unit on sediment deposition was considered negligible.

C.1.40. The inlet structure for the Henderson management unit is the Courtableau Freshwater Diversion Structure, which is two 10-foot box culverts with invert elevations of 10 feet, located in the west Atchafalaya River levee at mile 48. This structure would be a gated culvert designed to pass up to 3,000 cfs. The exact location of the structure has not been determined at this time as several feasible sites exist. The hydrograph shown on Plate C-38 uses the structure located at mile 48 (Bayou Courtableau). If the structure were moved downstream about 5 miles to Indian Bayou, the hydrograph would be about 0.5 foot lower. If the structure were located at mile 45 at Big Bayou Graw, the hydrograph would be about 0.5 foot higher. The Henderson unit also received inflowing discharges from the existing Courtableau drainage structure in the West Atchafalaya Basin Protection Levee (WABPL). The average discharge hydrograph through the drainage structure was computed using observed discharges for 1968, 1969, and 1976. Other years were excluded because of dry periods occurring during times of high discharges in the Atchafalaya River, and very wet periods during times of low discharges in the Atchafalaya River.

[2/] Unless noted otherwise, all elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD).

C.1.41. A trial and error procedure was used to find the dimensions of the outlet weir that would result in a computed stage hydrograph that most closely approximates the desired hydrograph. This was performed for the unit with and without the Courtableau freshwater structure.

C.1.42. The result of the investigation was an outlet 20 feet long with a crest elevation of 9 feet for conditions with the freshwater structure. Plate C-38 shows the approximation of the desired hydrograph. For conditions without the freshwater structure, an outlet 40 feet long with a crest elevation of 9 feet was chosen. The closest approximation of the desired hydrograph for this case is shown on Plate C-39. It should be noted that only 3 years of record were used to compute the inflow hydrograph from the existing Courtableau drainage structure and that the inflow comes from a different watershed.

C.1.43. Since Buffalo Cove and Henderson were targeted as pilot management units, investigations of the remaining units were not as indepth. These investigations were made only to determine how close the desired hydrographs could be approximated without a detailed trial and error study of the sizes of the inlets and outlets. The closest approximations of the desired hydrographs for each unit are shown on Plates C-40 through C-47.

FREQUENCY CURVES - PARTIAL YEAR

C.1.44. As discussed in Appendix G, potential land clearing calculations were based on the number of acres flood free three out of five years during the growing season (1 June through 30 November). To define this elevation, stage frequency curves for the growing season were developed for each management unit area. Since stages in each unit area are related to the Simmesport discharge, the frequency analysis was run only on the Simmesport discharges.

C.1.45. The highest discharge for each calendar year during the period 1 June through 30 November was used for the analysis. Since the study period occurs during the low part of the hydrograph, 1 June was usually the day the highest discharge occurred. A frequency analysis was run on these discharges using the "Flood Flow Frequency Analysis" computer program. From the results of this program and from the stage-discharge relationships, the stage-frequency curve for each unit was drawn.

C.1.46. For conditions with the management units in place, the frequency curves were computed by comparing the 1 June stage, both with and without management unit conditions. This difference in stage was the extent the frequency curve without the management unit was

with the management unit. The date of 1 June was selected because this was usually the day of the discharge used to compute the original frequency curve.

C.1.47. Since the stage with a 40-percent exceedance frequency was the only point used from these frequency curves, the curves are not reproduced in this report, but the 40-percent stages are shown in Table C-1-1. The stages with a 40-percent exceedance frequency for Bayou Boeuf at Amelia are 2.6 for present conditions, 4.1 for future without the Avoca Island levee extension, and 2.3 for conditions with the levee extension. The respective stages for Pierre Pass at Pierre Part are 2.8, 4.2, and 2.5.

TABLE C-1-1

40 PERCENT EXCEEDANCE FREQUENCY STAGES - 1 JUNE THROUGH 30 NOVEMBER
(In Feet NGVD)

Management Unit	Present	W/O Management Units			With MU	
		FWO	NED	RCMD	EQ	RCMD
Henderson	15.9	14.3	13.2	13.4	15.4	15.4
Lost Lake	16.9	15.6	14.3	14.5	16.9	-
Cow Island Lake	16.7	15.4	14.1	14.3	16.7	-
Warner Lake	16.7	15.4	14.1	14.3	16.7	-
Cocodrie Swamp	13.6	12.3	11.0	11.2	13.6	13.6
Beau Bayou	11.5	10.0	8.5	8.9	12.9	12.9
Buffalo Cove	9.9	8.8	7.5	7.8	10.1	10.1
Alabama Bayou	12.3	10.8	9.7	10.0	18.3	-
Bayou Des Glaises	12.3	10.8	9.7	10.0	12.7	-
Pigeon Bay	10.2	8.7	7.5	7.7	10.8	-
Flat Lake	6.8	5.5	4.4	4.6	6.8	6.8
Upper Belle River	5.5	5.0	3.4	4.2	6.3	-

FREQUENCY CURVES - BACKWATER AREA

C.1.48. The backwater area east of Morgan City is bounded on the west by the East Atchafalaya Basin Protection Levee (EABPL), on the east by the Mississippi River levee and Bayou Lafourche Ridge, and on the north by Lower Grand River and Bayou Plaquemine (Plate C-48). This area was cut off from direct flooding of the Atchafalaya River and Mississippi River by construction of the EABPL and the Mississippi River levees. However, backwater from the Lower Atchafalaya River can cause considerable increases in the water level in the vicinity of Bayou Boeuf which, in turn, increases flooding in the Lake Verret watershed by hindering the runoff from the area.

C.1.49. This area is not only subject to backwater flooding but is also subject to tidal flooding and headwater flooding. Tidal flooding is caused by wind-generated tides in the marshes and bays that act as a buffer in the Gulf of Mexico. The most severe tides occur during a hurricane. During Hurricane Audrey in June 1957, the combination of wind, significant river discharge, and simultaneous rainfall over the areas produced stages at Morgan City as high as 8.5 feet and 3.3 feet at Pierre Pass. Singularly, tidal flooding has been the predominant influence less than 1 percent of the time. The tides may be only 2 feet in height and of little significance when they occur singularly.

C.1.50. Headwater flooding has been the predominant influence slightly less than one-half of the time. This type of flooding which occurs because rainfall in the watershed is greater than the drainage system and natural storage system can accommodate, is usually of relatively short duration.

C.1.51. Backwater flooding has been predominant slightly more than one-half of the time and is by its nature almost invariably an inseparable combination of wind tides, rainfall runoff, and river-induced backwater. Flooding caused by backwater from the Atchafalaya River is usually of extended duration.

C.1.52. The Avoca Island levee was constructed to limit the project design flood stages in the backwater area to generally the same areas as those inundated in the 1945 flood. However, as development of the Atchafalaya River delta has taken place, the stage at the end of the levee for the project flood has escalated and the degree of backwater flooding has increased. As deltaic development continues, the mouth of the Atchafalaya River will continue to move gulfward, and stages at the end of the levee, and therefore stages in the backwater area due to backwater flooding, will continue to increase.

C.1.53. In contrast to the backwater flooding, the degree of flooding in the backwater area caused by tide or headwater runoff will remain constant, since these are caused by hydrologic conditions and are not affected by deltaic activity. For this reason, the percentage of time that backwater is the predominant influence of flooding is expected to increase from slightly more than one-half of the time, as it is now, to somewhat more than two-thirds of the time.

C.1.54. Stage-frequency curves were developed from historical data gaging stations in the backwater area (Plate C-48). Peak stages were used for the period of record (1957-1975). The stages were individually adjusted to represent peak stages with a mean tide in the Gulf of Mexico. The Plotting Position Method, as described in "Statistical Methods in Hydrology" by Leo R. Beard, was applied to the adjusted data to develop a stage-frequency curve at each location for present conditions.

C.1.55. Computations using HEC-2 were performed to quantify the effects delta development will have on stages at the end of the Avoca Island levee. This increase in stages was extrapolated to the gaging stations in the backwater area to obtain stage-frequency curves for future conditions. A similar computation was performed to develop stage-frequency curves for future conditions with the extension of the Avoca Island levee.

C.1.56. The curves described previously include the effects of backwater flooding, headwater flooding, and mean tide conditions. Additional stage-frequency curves were developed at selected stations to represent rainfall only with a mean tide. Stage-frequency curves for all the conditions discussed above are shown in Plates C-49 through C-54.

DURATION CURVES

C.1.57. Stage-duration curves were developed for the gaging stations in the backwater area described previously. These curves were developed from historical data, modified in the same manner as the stage-frequency curves. These curves are shown on Plates C-55 through C-60.

DELTA DEVELOPMENT

C.1.58. The Atchafalaya Bay is an actively building delta of the Atchafalaya River and is an ongoing subject of extensive study by aerial and land reconnaissance. Through these studies, past development has been cataloged, and projections of the amount of land expected to form in the next 50 years have been made (Plate C-61). Since the formation of the delta is not only caused by the sediment load of the Atchafalaya River but by wind and wave action of the bay, locations of the projected land development have not been specifically identified; only a gross area of development is shown (Plate C-62).

C.1.59. A hybrid modeling effort utilizing 12 mathematical and physical models is currently being undertaken by WES to develop a set of tools to predict evolution of the Atchafalaya River delta and effects of that evolution. Once complete, the model will provide a measure of refining predictions of develoment of the bay.

ISOHALINES

C.1.60. The salt-freshwater interface of the Atchafalaya Bay and vicinity is of vital importance to environmental concerns. The

marshes in this area contribute considerably to the fish and wildlife production of the Atchafalaya. To identify the effect alternatives would have on this salt-freshwater interface, salinity isohalines were drawn for the area from the Terrebonne marsh to Vermilion Bay. The maps shown on Plates C-63 to C-80 contain salinity isohalines for 0.5, 5.0, 10.0, 15.0, and 20.0 parts per thousand (ppt).

C.1.61. The existing conditions isohalines were developed from salinity data taken from 1974-1978 from 28 stations. Additional data obtained by the State of Louisiana were also used. Salinity data for each station were plotted versus Atchafalaya River discharges for corresponding dates. The data resulted in a plot with considerable scatter. A curve was drawn through the data to represent average conditions. To assist in locating this curve, ground truth information was used. This information consisted of locations of specific marsh types, location of oyster beds, and the salinity required to produce these habitats. After drawing a curve through the scatter of data, salinities were read from the curve for discharges of 320,000 cfs and 90,000 cfs. These values were located on the map and isohalines were then drawn through the data to represent present conditions. The same curves were used to estimate salinities for various distribution of flow between Wax Lake Outlet and the Lower Atchafalaya River for present conditions.

C.1.62. The future conditions isohalines were superimposed on the shoreline geography projected for the year 2030. Since the mouths of the two outlets will be located on the open gulf rather than the present bay-marsh system, allowances had to be made for the introduction of freshwater directly into open gulf waters. In addition, allowances were made for the reduction in future freshwater flows into surrounding marsh areas, a condition which will also result from the more direct outflow of freshwater into the gulf. With these concepts in mind, the future isohalines were shaped in a manner similar to those described for present conditions. Salinity gradients were found to be more severe near the mouths of the outlets because of the abrupt contact with open gulf waters. Salinity intrusion into the eastern marshes was hypothesized due to the reduction in freshwater flows into these areas. Salinity levels in East Cote Blanche Bay will be noticeably reduced by future flows. West Cote Blanche Bay and Vermilion Bay were not as affected by these future conditions.

PROJECT FLOOD FLOWLINES

C.1.63. General. The Atchafalaya Basin Floodway is being constructed to convey 1,500,000 cfs to the Gulf of Mexico during a project flood. Use of the area as a floodway is the primary use. The effect each alternative plan will have on the project flood was evaluated and demonstrated by the project flood flowlines.

C.1.64. The interrelation between various alternatives makes it nearly impossible to define the effect of any single alternative. It is a combination of alternatives that influences the flowline. For example, channel training in the Lower Atchafalaya Floodway would have a certain effect on the flowline when combined with a 70/30 distribution control of the outlets, but would have considerably less effect if the distribution of flow in the outlets is not controlled.

C.1.65. In the earlier investigations, about 45 flowline computations were made for various combinations of alternatives in an attempt to identify the effects of each alternative on the flowline. These flowlines were used in the early plan formulation as described in Appendix B and are not presented here. The flowlines shown in Tables C-1-2 through C-1-11, calculated for the plans or combination of alternatives, were selected for presentation in this report. Levee stations are shown on Plate C-24.

C.1.66. Design Reaches. The Atchafalaya Basin was divided into six reaches (or runs), each representing one totally defined element of the basin. This includes function, geographical location, and discharge. The six reaches are shown on Plate C-81 and are described as follows.

- Lower Atchafalaya River. The existing mouth of the Lower Atchafalaya River is at mile 135.8; for 2030 conditions; this has been extended to mile 152.0. This reach covers the area from mile 103.0 to the mouth of the river. Overbank areas have been extended to represent future conditions.

C.1.67. The project design discharge for the latitude of the outlets is 1,500,000 cfs. The distribution of flow through the outlets was determined by balancing the water surface elevation for Wax Lake Outlet and the Lower Atchafalaya River at their junction. This was done by developing a rating curve for each outlet. The rating curves were drawn by running discharges in increments of 100,000 cfs down each outlet. Each run used a starting water surface elevation of 5 feet to simulate extreme high tide in the bay.

C.1.68. The rating curves were plotted on a single graph (Plate C-82). Knowing the total latitude flow at the outlets, the combined rating curve will give the discharge in each outlet and the starting water surface elevation for the Middle Basin run. A similar combined rating curve was prepared for each alternative plan in this manner.

TABLE C-1-2

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - EAST BANK LEVEE
SIMMESPORT TO MORGANZA UPPER GUIDE LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
250+00	59.2	59.4	58.4	58.4	58.4	58.4
883+00	54.5	54.5	53.6	53.6	53.6	53.6
1305+93	50.3	50.5	49.6	49.3	49.3	49.3

TABLE C-1-3

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - EAST BANK LEVEE
MORGANZA UPPER GUIDE LEVEE TO END

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
1305+93	45.7	46.6	46.0	46.1	46.1	46.1
1360+00	45.4	46.2	45.6	45.6	45.6	45.6
1851+00	42.0	43.0	41.6	41.6	41.6	41.6
2110+00	38.5	39.6	38.7	38.7	38.7	38.7
2404+00	35.6	36.9	35.9	35.9	35.9	35.9
2769+25	30.3	31.9	30.7	30.7	30.7	30.7

TABLE C-1-4

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - WEST BANK LEVEE

Design Flowline Elevations, Feet NGVD

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
429+00	59.2	59.2	58.2	58.1	58.1	58.1
1010+00	54.8	55.3	54.2	54.2	54.2	54.2
1213+00	53.3	53.8	52.9	52.9	52.9	52.9
1445+00	51.1	51.7	50.6	50.5	50.5	50.5
2081+00	45.7	46.7	45.5	45.5	45.5	45.5
2380+00	42.7	43.7	42.6	42.4	42.4	42.4
2774+00	38.9	40.3	39.3	39.0	39.0	39.0
2996+00	36.3	37.9	35.8	35.6	35.6	35.6

TABLE C-1-5

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - BUTTE LAROSE LEVEE

Design Flowline Elevations, Feet NGVD

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
3005+00	33.0	34.3	33.2	33.0	33.1	33.0
3600+00	26.5	28.2	27.7	27.4	27.5	27.4

TABLE C-1-6

PROJECT FLOOD FLOWLINES
MORGANZA FLOODWAY - UPPER GUIDE LEVEE

Design Flowline Elevations, Feet NGVD

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
0+00	58.7	58.7	58.7	58.7	58.7	58.7
159+40	58.7	58.7	58.7	58.7	58.7	58.7
161+00	54.8	55.0	54.9	54.9	54.9	54.9
359+50	52.9	53.2	52.9	52.9	52.9	52.9
630+03.9	49.0	50.4	50.0	50.0	50.0	50.0

TABLE C-1-7

PROJECT FLOOD FLOWLINES
MORGANZA FLOODWAY - LOWER GUIDE LEVEE

Design Flowline Elevations, Feet NGVD

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
5+75	57.6	57.6	57.6	57.6	57.6	57.6
380+00	48.3	49.5	49.4	48.7	48.8	48.7
587+00	45.7	47.4	47.2	46.1	46.2	46.1
858+00	41.8	42.9	42.2	42.2	42.3	42.2
1033+43	38.8	40.3	39.3	39.2	39.3	39.2

TABLE C-1-8

PROJECT FLOOD FLOWLINES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE

Design Flowline Elevations, Feet NGVD

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
1033+43	38.8	40.3	39.2	39.2	39.3	39.2
1316+00	37.1	38.4	37.5	37.4	37.5	37.4
1629+00	35.5	37.1	36.2	36.0	36.2	36.0
1858+00	34.4	36.0	35.0	34.7	34.9	34.6
1915+00	33.7	35.1	34.3	34.2	34.2	34.0
2188+00	32.2	33.6	32.6	32.4	32.7	32.4
2580+00	30.5	31.9	30.8	30.5	30.7	30.4
2773+00	30.1	31.4	30.4	30.1	30.2	29.9
2950+60.5	29.7	31.1	30.0	29.7	29.7	29.4
770+00	29.3	30.5	29.4	29.0	29.4	28.9
899+00	28.8	30.2	29.1	28.7	28.9	28.5
1100+00	28.4	29.7	28.5	28.2	28.4	28.0
1361+00	27.5	28.7	27.4	27.0	27.2	27.0
1554+00	26.8	28.0	26.4	26.0	26.2	25.7
1620+00	26.3	27.5	26.0	25.6	25.8	25.3
1700+00	25.8	26.9	25.4	25.0	25.2	24.6
1780+00	25.4	26.2	24.8	24.3	24.6	23.9
1960+00	24.2	24.4	23.3	22.8	23.1	22.3
2040+00	23.7	23.7	22.8	22.3	22.7	21.6
2090+00	23.3	23.3	22.7	22.1	22.6	21.5
2210+00	22.8	22.8	22.1	21.8	22.1	21.0
2400+46= 66+74	21.2	21.2	20.1	20.2	20.2	18.9
0+00	19.3	19.3	18.1	18.2	18.5	16.5

TABLE C-1-9

PROJECT FLOOD FLOWLINES
LEVEE SOUTH OF MORGAN CITY (AVOCA ISLAND)

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
	Design Flowline Elevations, Feet NGVD					
0+00	18.0	18.0	17.3	17.2	17.4	15.4
128+33[1/]	18.0	18.0	17.3	17.2	17.4	15.4
1+13.8[2/]	18.0	18.0	17.3	17.2	17.4	15.4
200+00	16.3	16.3	15.4	16.8	17.1	14.8
349+00	15.1	15.1	14.1	16.1	16.3	13.6
457+00	14.3	14.3	13.6	15.8	16.1	13.0
680+00	13.2	13.2	12.4	14.4	14.8	11.9

[1/] N Edge Bayou Boeuf Lock

[2/] S Edge Bayou Boeuf Lock

TABLE C-1-10

PROJECT FLOOD FLOWLINES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
0+00	57.1	57.1	57.0	57.0	57.0	57.0
511+00	49.0	49.0	49.0	49.0	49.0	49.0
990+00	46.4	46.4	46.4	46.4	46.4	46.4
1395+00	43.7	44.3	44.3	44.2	44.2	44.2
1788+00	41.0	41.9	41.9	41.4	41.4	41.4
2182+00	38.9	39.9	39.9	39.6	39.6	39.6
2510+00	37.4	38.8	38.8	38.7	38.7	38.6
2902+00	35.6	37.2	36.1	36.0	36.0	35.9
3310+00	32.2	33.7	32.6	32.3	32.6	32.4
3560+00	31.2	32.6	31.6	31.4	31.4	31.1
3698+00	30.9	32.2	31.1	31.0	31.0	30.7
3957+00	30.1	31.5	30.4	30.0	30.3	29.9
4269+00	29.2	30.6	29.4	29.0	29.3	28.9
4547+00	28.7	30.0	28.8	28.4	28.6	28.2
4717+00	28.5	29.8	28.5	28.1	28.3	28.0
4947+00	27.8	29.1	27.6	27.3	27.6	27.1
5100+00	27.2	28.5	27.1	26.2	27.0	26.5
5493+00	25.2	25.2	24.5	24.0	24.3	23.5
5644+00	23.5	23.5	21.8	21.1	21.3	20.1

TABLE C-1-10 (Continued)

PROJECT FLOOD FLOWLINES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
	Design Flowline Elevations, Feet NGVD					
West Calumet Floodgate						
5730+09	20.6	20.6	19.0	18.1	18.3	17.6
5817+00	23.2	23.2	21.6	21.0	21.2	20.4
5914+00	24.3	24.3	23.0	22.3	22.7	21.9
6030+00	24.1	24.1	23.1	22.7	23.0	22.0
6336+00	23.2	23.2	22.5	22.1	22.5	21.4
6433+00	22.5	22.5	22.0	21.9	21.5	20.2
6551+28 = 625+07	20.9	20.9	19.2	19.7	19.8	18.4
703+50	17.9	17.9	16.9	18.0	18.5	16.7
838+87 = 0+00	17.0	17.0	15.9	17.2	17.5	15.3
60+00	15.7	15.7	14.7	16.4	16.7	14.2

TABLE C-1-11

PROJECT FLOOD FLOWLINES
LEVEES WEST OF BERWICK

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
	Design Flowline Elevations, Feet NGVD					
Wax Lake East						
60+00	15.7	15.7	14.7	16.4	16.7	14.2
356+00	13.6	13.6	14.9	15.4	15.6	15.0
508+85= 268+84	14.0	14.0	15.8	15.9	16.1	15.6
Wax Lake Outlet East						
268+84	14.0	14.0	15.8	15.9	16.1	15.6
179+50	16.8	16.8	17.3	17.2	17.4	16.7
160+82	20.6	20.6	18.1	18.1	18.4	17.6
Wax Lake Outlet West						
143+04	20.6	20.6	18.1	18.1	18.4	17.6
320+04	13.6	13.6	15.0	15.5	15.6	15.1
0+00	13.6	13.6	15.0	15.6	15.7	15.3
269+00	10.4	10.4	13.4	14.1	14.2	13.9
East Bayou Sale						
273+75	10.0	10.0	13.1	13.9	13.9	13.6
190+00	9.8	9.8	12.9	13.8	13.8	13.5
0+00	9.4	9.4	12.5	13.6	13.6	13.3

C.1.69. The project flood flowline was computed for the Lower Atchafalaya River and Wax Lake Outlet using the discharges obtained from the combined rating curve and a starting water surface elevation of 5 feet.

• Wax Lake Outlet. The existing mouth of Wax Lake Outlet is at mile 122.0. For 2030 conditions this has been extended to mile 136.0. This reach covers the area from mile 104.7 to the mouth of the outlet. Overbank areas have been extended to represent future conditions. Design flow for Wax Lake Outlet is determined along with the flow for the Lower Atchafalaya River as described previously.

• Middle Basin. This reach extends from mile 107.0 to mile 53.49. The overbank areas extend eastward to the EABPL and westward to the WABPL. The project flood discharge for the middle basin is 1,500,000 cfs. The middle basin reach is also used to define the project flood flowline for the Butte LaRose levee. This levee is authorized to have a grade to confine a flow of 1,000,000 cfs supplied by the river and Morganza Floodway; therefore, the flowlines for this levee reflect this lower than project floodflow condition.

• Atchafalaya River from Whiskey Bay Pilot Channel to Old River. This reach extends from mile 53.5 to Old River and computes the flowline for both river levees. Because of the varying functions of the river levees the flowlines for this reach were divided into three segments, each with a different design discharge. The Atchafalaya River east bank levee from Simmesport to junction with Morganza upper guide levee (Reach 1 of Plate C-81), uses a design discharge of 832,000 cfs in the Atchafalaya River and 1,500,000 cfs in the Middle Basin. The Atchafalaya River east bank levee, Morganza upper guide levee to Alabama Bayou (Reach 2, Plate C-81), uses 800,000 cfs in the Atchafalaya River and 800,000 cfs in the Middle Basin. The Atchafalaya River west bank levee, Simmesport to junction with the Butte LaRose levee (Reach 3 of Plate C-81), uses 832,000 cfs in the Atchafalaya River and 1,432,000 cfs in the Middle Basin. Derivation of these design discharges is explained in "MR&T Project Flood Flowline Review Report," December 1976, revised September 1977.

• West Atchafalaya Floodway. This reach extends from mile 53.5 northward to the fuseplug levee west of Simmesport. The design discharge is 250,000 cfs above Bayou Current and 400,000 cfs below Bayou Current. Since the West Atchafalaya Floodway is operated after operation of the Atchafalaya River and Morganza Floodway, the starting elevation for these computations is based on a discharge of 1,500,000 cfs in the Middle Basin.

• Morganza Floodway. This reach extends from mile 53.5 up to the Morganza control structure and provides design flowlines for the Morganza upper and lower guide levees. The design discharge is 600,000 cfs with 1,500,000 cfs in the Middle Basin.

C.1.70. Computational Procedure. The project flood flowlines were computed by use of the HEC-2 computer program described previously. Details of the model calibration can be found in the "MR&T Project Flood Flowline Review Report," December 1976, revised September 1977.

C.1.71. For each alternative plan, channel cross sections were coded, based on the following:

- Channel areas based on projections shown on the channel development curves.

- Projection of the amount of sediment deposition on overbanks and delta development.

- Alternative features of the plan such as channel training, widening Wax Lake Outlet, and the Avoca Island levee extension.

C.1.72. Computations began by construction of the combined rating curve for the Lower Atchafalaya River and Wax Lake Outlet. From this curve the design discharges for each outlet and the starting water surface elevation for the Middle Basin run were obtained. The Lower Atchafalaya River run with this discharge provides design grades for the Avoca Island levee, Morgan City, Tiger Island and Berwick floodwalls, and the lower end of the EABPL.

C.1.73. Results from the Wax Lake Outlet run were used for design grades for the Wax Lake Outlet levees the lower end of the WABPL, and the levees west of Wax Lake Outlet.

C.1.74. Computations from the Middle Basin run were performed next to establish design grades on the EABPL and WABPL. This reach also had to be run for the appropriate discharges to establish starting water surface elevations for the Atchafalaya River levees.

C.1.75. Computation of the design grades for the Atchafalaya River levees, Morganza levees, and WABPL adjacent to the West Atchafalaya Floodway completed the flowline calculations.

Section 2 - EVALUATION OF ALTERNATIVES

GENERAL

C.2.1. Detailed descriptions of alternative features considered by this study are contained in the main report. The following paragraphs present a summary of the hydraulic evaluation of the alternatives. Those alternatives eliminated from further investigation, during the plan formulation of the study, are not covered here, except for those, such as Old River control diversion for which flood control considerations were the major factor in the elimination of the alternative.

OLD RIVER CONTROL

C.2.2 Old River control was constructed and put into operation in 1963 to restrict the quantity of flow diverted to the Atchafalaya River in order to combat the capture of the Mississippi River. The distribution of total latitude flow between the Mississippi and Atchafalaya Rivers below Old River is regulated to 70/30 (70 percent to the Mississippi River and 30 percent to the Atchafalaya River) on an annual basis in accordance with the authorizing law (Flood Control Act of 1954). Investigations were made to change this distribution to divert either more or less water to the Atchafalaya River.

C.2.3. As described in Appendix B, several distributions of flow at Old River were considered. These included 70/30, 60/40, 65/35, and 80/20 distributions. It also included operating the complex to maintain a 35-, 40-, or 45-foot water surface elevation at Acme, Louisiana, when the differential head on the structure would allow. An additional alternative attempted to maintain 35 feet at Acme without a differential head restriction. For each of these alternatives, the discharge hydrographs for both the Mississippi and Atchafalaya Rivers were computed, using as a base the observed hydrographs of 1949-1974. The effects of each distribution in the floodway, saltwater intrusion, and land use were determined.

C.2.4. The alternatives that diverted a smaller percent of the flow to the Atchafalaya River (80/20, and 35, 40, and 45 feet at Acme) tended to cause less development in the Atchafalaya Basin outlets and thereby a higher flowline in this critical area. Other reasons for eliminating these alternatives from further consideration during the plan formulation stage are addressed in Appendix B. Reasons for eliminating the 60/40 and 65/35 distributions from further consideration are largely hydraulic in nature and are addressed in the following paragraphs.

C.2.5. The definitive study of the relationship between the Mississippi and Atchafalaya Rivers, performed in 1952, is entitled

"Geologic Investigation of the Atchafalaya Basin and the Problem of Mississippi River Diversion." That study predicted that a critical stage in the relationship would occur when diversions from the Mississippi River at the natural Old River connection reached about 40 percent of the Mississippi River flow. Had natural conditions been allowed to continue until the present time, it is estimated that the distribution of flow would now be 55/45, and the behavior of the Mississippi River would, no doubt, be marked by great instability. Events have provided data that demonstrate that the critical stage was actually closely approached in the 1973-1975 time period at a distribution of only 65/35.

C.2.6. In 1976, operation of Old River proceeded with the goal of maintaining a 70/30 distribution on a daily basis. Prior to that time, distribution of flows was not controlled daily and in 1974, the Mississippi River carried as little as 56 percent of the daily latitude flow. Under the influence of daily control, steady increases in channel capacity at Tarbert Landing were reflected by the rating curves in 1977, 1978, and the early part of 1979. Events during the 1979 flood showed the Mississippi River to be subject to rapid change. Large amounts of deposition in May 1979 caused a significant rise in the rating curve at Tarbert Landing. It is likely that if the 1979 flood had occurred with the 1975 channel conditions, peak stages at Old River control would have been substantially higher than those actually encountered.

C.2.7. While the events of the 1979 flood do not, in themselves, comprise an unassailable case for maintaining a 70/30 distribution of latitude flow, combined with the behavior of the Tarbert Landing rating curves in 1976, 1977, and 1978, they do indicate very clearly that any change in that distribution toward placing a greater share of total latitude flow into the Atchafalaya River would be risky, if not irresponsible. This conclusion is supported by the results of movable bed model studies and numerical model studies.

C.2.8. A plan to maintain less than a 70 percent distribution to the Mississippi River would cause rapid deterioration in the flow capacity of the Mississippi River over substantial lengths of the channel. This instability would mandate a change in the distribution of project floodflow, and the Atchafalaya Basin would have to accept a greater share of that flow, but could, in all probability, not accommodate such flow within the basin's levee system.

C.2.9. Based on studies to date, including those that support the authorization of Old River control, and in particular the analysis of the behavior of the Atchafalaya and Mississippi Rivers over the period of 1973 to date, it has been concluded that, to maintain a stable relationship between the two streams, not less than 70 percent of the total annual volume of latitude flow should be passed through the Morganza-Old River reach of the Mississippi River. Day-to-day

departures from this general operating rule are permissible, but the margin for such departures is quite narrow. Two factors, primarily, contribute to this. First, it is impossible to predict the subsequent hydrograph of latitude flow; and second, the ability to redress volumetric imbalances, created by departures from the general operating rule which favors flow in the Atchafalaya River, is constrained by the allowable differential heads that may be safely imposed on the low sill structure. Combined, these two factors would preclude assurance that, having diverted additional flow to the Atchafalaya River, the imbalance created could, in fact, be subsequently corrected. The greater the total flow at which the departure occurs, the greater the likelihood that it will be impossible to meet the requirements of the general rule.

CHANNEL DEVELOPMENT

C.2.10. The Atchafalaya River main channel consists of: a leveed reach from the junction of Red River and Old River to mile 55; the main channel of the floodway to about mile 100; a channel through former lakes; and the outlets to the gulf. Hydrographic surveys of the channels have been made periodically since the late 1800's. The channel area calculations represent the area below the 1963 flowline, which is a fixed datum. The areas for several cross sections spread over a few miles are averaged for each survey to give the average area for a reach. The areas for several reaches were averaged to get average channel areas for mile 0-54.8 (leveed reach), mile 54.8-65.4 (Whiskey Bay Pilot Channel), mile 65.4-100.8 (distributary reach), mile 100.8-113.7 (lake area), mile 105.5-124.0 (Wax Lake Outlet), and mile 113.7-136.8 (Lower Atchafalaya River).

C.2.11. Since removal of the rafts in the Atchafalaya River in 1855, the cross-sectional area has continued to increase; the lakes in the lower part of the basin have filled with sediments; and the development of a main channel through the lakes has taken place. The objective of dredging the main channel from 1955 to 1968 was to accelerate development of this channel. Concurrent with the dredging program, closure of 22 distributaries was accomplished to confine a larger percent of the flow to the main channel which, in turn, accelerates the natural erosive action of the river to establish a larger main channel. Projections of future channel development were based upon projections of changes in flow distribution and to some extent model results of the computer model HEC-6. As shown on Plates C-1 through C-8 the area of the river has progressed to approximately 118,000 sf from mile 0 to mile 54.8; to 92,000 sf from mile 54.8 to 65.4; to 80,000 sf from mile 65.4 to 100.8, and to 38,000 sf from mile 100.8 to 113.7. The area of the Lower Atchafalaya River (mile 113.7-136.8) has decreased to about 69,000 sf. This is primariy due to the loss of flow to the Wax Lake Outlet, which has increased its area to 38,000 sf.

C.2.12. No Action. If no further action is taken in the basin, the area of the main channel would continue to increase as shown on the channel development curves (Plates C-1 through C-8). The continued channel enlargement of the leveed reach of the river will result in a 121,000-sf channel by the year 2030. As the natural levees of the main channel in the Lower Atchafalaya Basin Floodway are formed, a larger percentage of the flow will be confined to the channel and will result in its continued natural enlargement. The channel cross-sectional area between mile 54.8 and 65.4 is projected to increase to 110,000 sf. Between mile 65.4 and mile 100.8, the channel cross section will increase to 98,000 sf.

C.2.13. Wax Lake Outlet, with its gradient advantage for flow to the gulf over the Lower Atchafalaya River, will continue to convey an increasing percent of the latitude flow. It is estimated that by 2030, approximately 50 percent of the latitude flow will be conveyed through Wax Lake Outlet. Concurrent with this increasing flow, the cross-sectional area of Wax Lake Outlet will increase to about 51,000 sf. Because of the concurrent decreases in flow, the main channel's cross section below river mile 100 will decrease in area. From mile 100.8 to mile 113.7 the area is projected to decrease in size to about 17,000 sf by 2030. The area of the Lower Atchafalaya River (mile 113.7 to 136.0) will decrease to about 47,000 sf.

C.2.14. This evident shift in the distribution of flow through the outlets, toward a larger part of the total flow being conveyed by Wax Lake Outlet, will have the effect of a loss in total conveyance capacity of the outlets. This, along with the projected overbank sediment deposition, will cause the project flood flowline to become higher than if some alternate action were taken. The no-action flowline is projected to be higher than the 1973 refined flowline by up to 1.5 feet. This higher flowline effect extends along the EABPL, WABPL, Morganza Floodway levees, and the Atchafalaya River levees.

C.2.15. The no-action alternative or without-project condition affects the average stage hydrographs in the same manner as the project flood flowline. The peak stages expected for the average hydrograph will be higher for no-action than they will be if preventive alternative actions were taken. The differences in magnitude are generally between 1 and 2 feet higher for all areas of the basin and are shown in the average stage hydrographs for each management unit area (Plates C-28 through C-36).

C.2.16. Dredge 100,000-sf Channel. The dredged 100,000-sf channel plan, as presented in 1963, calls for dredging from mile 54.5 to mile 111.9 in steps of 60,000 sf, 80,000 sf, and 100,000 sf. The plan included continuous monitoring to determine if the next step of dredging would be required.

C.2.17. Of the 443,000,000 cubic yards (cy) of dredging expected in 1963, 158,000,000 cy were completed through 1968. Due to the natural

erosive action of the river, enlargement has continued since 1968 so that it is now estimated that 240,000,000 cy would need to be dredged to complete the project. The plan also included closure of the Atchafalaya River just below the Whiskey Bay Pilot Channel.

C.2.18. Development of the main channel is an important factor in flood control, since the main channel is expected to carry one-third of the basin flow during a project flood. Development of the main channel through dredging is the most expeditious manner of obtaining a floodway capable of conveying the project flood.

C.2.19. Channel Training. Channel training is a process consisting of dredging material from the channel and placing it on the bank, to simulate the development of natural ridges. Once in place the training works would confine more flow to the channel, which not only tends to accelerate its development, but reduces the overbank deposition occurring during the project life.

C.2.20. The channel training plan would authorize training works on both sides of the main channel, extending from the end of the river levees to the bay, and including both the Lower Atchafalaya River and Wax Lake Outlet. The training works above the outlets would be completely confining works; that is, there would be no gaps in the works to allow water to flow over the banks during low flows. The training works on the Lower Atchafalaya River and Wax Lake Outlet would not be completely confining works. Gaps would be left between disposal areas to allow for continued development of the overbank marshes. All the training works would be constructed to a height equal to that of the average annual high water of the area. This would allow, on the average, bi-annual overflow of the river.

C.2.21. Actual construction of channel training works would not be required over all the area described above. The majority of the works would be below mile 100. Above mile 100, the work would consist of closing gaps between existing disposal areas, elevating depressions in the natural levee, and maintaining the channel training works.

C.2.22. An additional integral part of channel training below Morgan City is the closure of Bayou Shaffer. Currently, Bayou Shaffer conveys about 12 percent of the flow that passes Morgan City. The closure of Bayou Shaffer will require all of this flow to be conveyed by the Lower Atchafalaya River. Since this closure and the channel training works would confine a larger quantity of water to the channel, a larger cross-sectional area could be maintained, resulting in a lower flood flowline.

C.2.23. Calculations performed during the earlier plan formulation stage of this study indicated that channel training above Morgan City would provide a net dollar savings by reducing the height to which levees would have to be constructed. The channel training works

resulted in an average reduction in the project flood flowline for future conditions for the EABPL and WABPL of about 0.5 foot. This comparison was made between conditions with channel training and between conditions with only natural development of the main channel. Other features included in this comparison that were common to both computations were 70/30 control of the outlets and widening the Wax Lake Outlet overbank.

C.2.24. Plan formulation calculations also indicated that channel training of the outlets and closure of Bayou Shaffer would provide a net benefit. Flowline calculations comparing conditions with and without channel training indicated that the flowline at Morgan City and Wax Lake Outlet could be reduced by about 1.0 foot. This reduction in flowline averaged about 0.5 foot for the EABPL and WABPL. Common features to this comparison were channel training on the Lower Atchafalaya Floodway, 70/30 control of the outlets, and widening the Wax Lake Outlet overbank.

C.2.25. Additional benefits from channel training are received because it will accelerate the time period in which the floodway will become capable of conveying the project flood. This acceleration is achieved by dredging to build the training works, which in itself enlarges the channel, and by a reduction in overbank deposition in the early years of the project.

OVERBANK DEVELOPMENT

C.2.26. The overbank area studied includes Atchafalaya Bay and all the area between the east and west protection levees, exclusive of the main channel. Sediment deposition on the overbanks reduces flow capacity and, therefore, causes a rise in the flowline. The area-elevation curves described earlier were used to illustrate projected changes in overbank deposition. Channel development alternatives have a considerable effect on the amount of overbank deposition. These effects were included in the area-elevation curves. Additional alternatives to reduce overbank deposition were considered and are discussed subsequently.

C.2.27. No Action. The process of a river overflowing its banks and depositing sediments in the adjacent land areas is a natural developing process of a young (in geologic time) river, such as, the Atchafalaya. Each year as the river conveys spring floods to the gulf, it will overflow its banks and continue to deposit sediments in the flooded overbank areas.

C.2.28. Projections of river overflow sediment deposits in the overbank areas are shown by the area-elevation curves for each management unit area (Plates C-9 through C-19). As the natural levees

within the Atchafalaya Basin build up to higher elevations from yearly overflows, the quantities of water diverted to the overbank areas will gradually decrease; therefore, the quantities of sediment deposited or rate of sediment deposition on the overbank areas would be expected to decrease over time. While the most significant amounts of deposition have already taken place over most of the basin, additional sediment deposition of up to 9 feet could occur in some areas.

C.2.29. The most significant areas of sediment deposition above the Teche Ridge will be in the lower lake areas. These areas are in a region where the main channel has yet to completely form natural levees; therefore, the overbanks are subject to frequent overflows. In the area of Sixmile and Grand Lakes, up to 9 feet of deposition can be expected. This building of the river banks in the area will eventually result in the main channel having confining natural levees throughout the Lower Atchafalaya Basin Floodway. The filling of the open water areas will continue and ultimately result in a relatively narrow channel through Sixmile Lake to Wax Lake Outlet.

C.2.30. Sediment deposition to the east of the main channel will not be as great in the more distant backswamps. For most of the Upper Belle River area, deposition of less than 2 feet is expected. This large area receives only about 16 percent of the total basin discharge, and the waters reaching the area will have already lost their heavy sediment load during the long distance traveled from the main channel. Because of the small amount of deposition expected, this area should maintain its present water regime. Like the Sixmile Lake area, higher deposition rates are expected in the southern and western portions of Upper Belle River as the main channel builds its natural levees; but since the main channel in this region is losing flow to Wax Lake Outlet, the deposition is expected to be no more than 5 feet and be confined to those lands within a mile of the main channel.

C.2.31. The area of Crevasse will be subject to up to 7 feet of sediment. This high rate of deposition is expected because practically all of the unit is located within the actively building natural levee portion of the main channel, and because of the significantly large volume of water that flows through Lake Chicot, Grand Lake, and Willow Cove during floods.

C.2.32. The Buffalo Cove area is bordered on the east by the main channel and on the west by Lake Fausse Pointe Cut. Because of the large flow conveyed through the Lake Fausse Point Cut (15 percent of the basin flow), Buffalo Cove is subject to levee building on both sides. Through the natural levee-building process, which has already taken place and the dredge disposal that was placed near the main channel, the eastern side of Buffalo Cove is already becoming a confining levee of the main channel. Along its western edge, particularly in the southwestern portion, water and sediment overflow into Buffalo Cove on a regular basis. In addition, access channels,

such as, the Si Bon Canal, convey a significant amount of water and sediment into the center of the area. These conditions subject the entire area of Buffalo Cove to about 5 feet of additional sediment deposition.

C.2.33. The remaining hydrologic areas of the Lower Atchafalaya Basin Floodway receive smaller quantities of water than those described above; therefore, expected deposition of sediments will be generally limited to the bank areas and will be less than 5 feet. Exceptions to this general pattern are the Warner Lake and Alabama Bayou areas. Warner Lake is completely surrounded by high banks and only about 1 foot of additional deposition is anticipated. Alabama Bayou is already well protected from main channel overflow by the east river levee. Therefore, except when the Morganza Floodway is operated, it is subject only to overflow from backwater that has already passed through most of the Bayou des Glaises area. Thus, no additional sediment deposition is expected in Alabama Bayou.

C.2.34. Sediment that passes through the Lower Atchafalaya Basin Floodway to the Atchafalaya Bay will continue to build the delta. As shown on Plate C-61, it is expected that about 300 square miles of land will emerge from this active deltaic process by the year 2030. If no action is taken to control flows through the outlets, Wax Lake Outlet will capture a larger share of the flow to be conveyed to the gulf. For this reason, a westward shift in the delta-building process will take place, with more land emerging near the mouth of Wax Lake Outlet.

C.2.35. Distributary Realinement. The Atchafalaya Basin main channel has four major distributaries. The Atchafalaya River at the head of the Whiskey Bay Pilot Channel distributes about 30 percent of the main channel flow to the western overbank areas. Some of this flow reenters the main channel 17 miles downstream through the west freshwater diversion channel. The west access channel diverts about 2 percent of the basin flow from the main channel near mile 75. The east freshwater diversion channel diverts about 3 percent of the basin flow from the main channel at mile 71.5, while the east access channel diverts about 3 percent of the basin flow from the main channel at mile 79. Along with the basin flow diverted from the main channel, these four distributaries divert sediments to the overbank areas.

C.2.36. The sediment transported by a distributary can be divided into two components: bed load and suspended load. The bed load consists of the coarser particles, or sand, and the suspended load generally consists of fine particles, such as silt and clay. There is no effective means to reduce the suspended load short of flocculation, which is extremely expensive and thereby infeasible for use in the Atchafalaya Basin Floodway. Bed load, on the other hand, can be effectively reduced in the distributaries.

C.2.37. At the present time, flow and the corresponding sediment load in the major distributary channels are diverted from the main channel at an angle of diversion of approximately 120 degrees, as shown in Figure C-2-1. A literature search of theoretical relationships and past model studies has shown that the alinement of the distributaries is such that they draw water from heavily sediment-laden, bottom currents of the main channel, and as much as 50 percent of the main channel bed load can be conveyed into the distributary and subsequently into the overbank areas. Realinement of each distributary to between 30 and 45 degrees (Figure C-2-2), can greatly reduce the bed load diverted to the distributary.

C.2.38. Since the sediment control features, both channel realinement and sediment traps, as described below would primarily have an effect on the sand size sediments, the amount of reduction of overbank deposition over the no-action deposition quantities has been estimated to be in proportion to the percent of sands in the suspended load (25 percent). This asumption has been made pending the results of an ongoing model study at WES of the west access channel realinement.

C.2.39. Sediment Traps. At each of the distributaries described previously, the use of sediment traps to remove sand-size sediments from the water column was investigated. The sediment traps would be rectangular and would in effect be an artificial deepening and widening of a reach of the distributary. The sediment traps, along with channel realinement, would reduce overbank deposition in the quantities described above.

C.2.40. The sediment traps were designed in the same manner that a settling basin for a treatment plant is designed. Sediment loads and grain sizes were obtained from sediment observations made in the distributary in 1975. Design details and annual maintenance estimates are shown in Table C-2-1. The excavated material would be placed on disposal areas parallel to the main channel to an approximately 20-foot depth. The disposal areas would not affect the project flood flowline because of their location.

OUTLET DISTRIBUTION

C.2.41. Wax Lake Outlet was completed in 1941, at which time it conveyed about 20 percent of the flow of the basin to the bay, while the Lower Atchafalaya River conveyed the remaining 80 percent. Since Wax Lake Outlet offers a shorter course to the bay than does the Lower Atchafalaya River, its share of the average flow has steadily increased to about 30 percent today. If nothing is done to prevent it, this trend will continue. Investigations were made on methods (and impacts) of changing the distribution to several alternatives, ranging from 100 percent through the Lower Atchafalaya River to 100

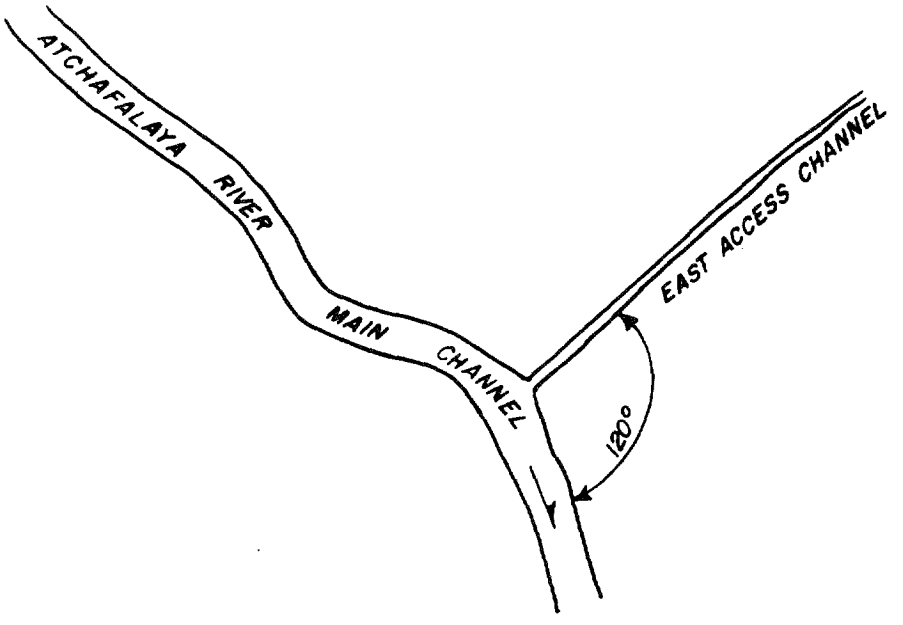


FIGURE C-2-1 TYPICAL EXISTING DISTRIBUTARY ALINEMENT

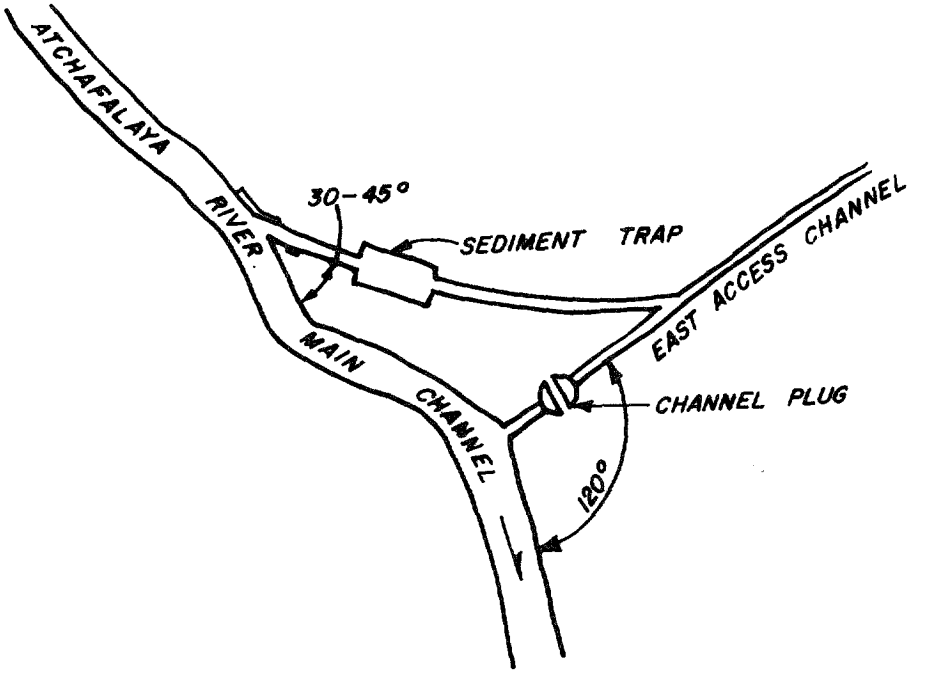


FIGURE C-2-2 TYPICAL DISTRIBUTARY REALINEMENT

TABLE C-2-1

SEDIMENT TRAP

Location	Width (feet)	Length (feet)	Bottom Elevation (ft NGVD)	Initial Excavation (cy)	Annual Maintenance (cy/yr)
No. 1 Atch. River at WBPC	1,400	2,500	-40.0	4,000,000	1,900,000
No. 2 West Access	300	1,000	-2.0	75,000	57,000
No. 3 East Freshwater	400	1,000	-10.0	215,000	90,000
No. 4 East Access	400	1,250	-10.0	275,000	80,000

percent through Wax Lake Outlet. Effects of each distribution are reflected in the channel development curves, the project flood flowlines, average hydrographs, and the isohalines.

C.2.42. No Action. The cross-sectional area of Wax Lake Outlet is currently about 38,000 sf. With the gradient advantage Wax Lake Outlet offers, this area would be expected to increase to 51,000 sf by the year 2030 (Plate C-2). Because of the loss of flow to Wax Lake Outlet, the area of the Lower Atchafalaya River would be expected to decrease from 69,000 to 47,000 sf. This shift in channel area is accompanied by a shift in the distribution of flow at the outlets. By the year 2030, the distribution of flow could be expected to be about 50/50. The shift in distribution results in a net loss in conveyance capacity of the outlets, thereby causing a rise in the project flood flowline. The shift in the distribution toward 50 percent through Wax Lake outlet will also increase maintenance dredging in the Lower Atchafalaya River. The shift would not affect the total quantity of delta emerging in the bay but would cause the location of the emerging delta to shift westward.

C.2.43. Control Outlet Distribution. The distribution of flow in the outlets is presently 70/30 (Lower Atchafalaya River/Wax Lake Outlet). An alternative to maintain this distribution consists of constructing a rock weir at the head of Grand Lake with connecting levees to the WABPL as shown on Plate 8 of the main report. The weir is designed to provide the 70/30 flow distribution for low and normal flows. For flood flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that the flow could be safely conveyed to the outlet. The flow distribution for a project flood would be about 80/20.

C.2.44. Two alternatives to reduce the flow conveyed to Wax Lake Outlet were considered. One alternative required a gated control structure at the head of Grand Lake to maintain an 80/20 distribution, since velocities occurring at the diversion point exceeded the safe capacity for a rock weir. The second alternative consisted of a low-level closure at the head of Grand Lake to maintain a 100/0 distribution. Both alternatives include the same low-level levee as described for the 70/30 split so that flood flows could be safely conveyed to the gulf.

C.2.45. An alternative to restrict flows out of the Lower Atchafalaya River was also considered. A 0/100 distribution would be maintained by construction of a closure dam, flood control structure, and a lock at mile 115 on the Lower Atchafalaya River. Low and normal flows through the Lower Atchafalaya River would be stopped or curtailed sharply. The distribution of flood flow would also be changed, with the majority of flood flows being conveyed by Wax Lake Outlet. The control structure would be gated to regulate flows. The navigation lock would be similar in size to the one existing at Bayou Sorrel.

Enlargement of both the normal conveyance channel and the overbank channel at Wax Lake Outlet would be required.

C.2.46. Restricting the flow through the Lower Atchafalaya River was eliminated from further consideration during the plan formulation stages of the study. The alternative would drastically change the isohalines in the bay and would increase saltwater intrusion in the Lower Atchafalaya River and the Terrebonne Marsh. The alternative would also require additional locks, a control structure, and extensive dredging in Wax Lake Outlet, and was the most expensive alternative considered.

C.2.47. Increasing the percent of flow conveyed by the Lower Atchafalaya River would offer long-term advantages to flood control by enabling the Lower Atchafalaya to maintain a larger cross-sectional area. However, the immediate effects of this alternative is to increase water levels at the end of the Avoca Island levee for normal flows. Model tests on the MBM indicated that closure of the Wax Lake Outlet would raise the stage at the end of the levee by as much as 0.9 foot for a basin discharge between 100,000 cfs and 600,000 cfs. The escalation of stages would occur prior to the increased development of the channel. The extra foot of water would increase the flooding in the backwater area. For this reason the alternatives included in the plans consisted of initial construction of a weir to maintain a 70/30 distribution. As gradual development of the Lower Atchafalaya River occurs, it may be possible to further restrict Wax Lake Outlet to a 80/20 or 100/0 distribution. Since this development is highly dependent on the type of hydrograph experienced, a fixed time frame for the further restrictions cannot be developed. The channel development curves reflect the changes in distribution occurring at 10-year intervals merely as a way to illustrate the alternative.

C.2.48. Widen Wax Lake Outlet. This alternative consists of setting back the west Wax Lake Outlet levee to the location shown on Plate 9 of the main report. The existing levee would be degraded to natural ground. This would allow use of the additional overbank area during floods exceeding the 10-year frequency. The additional overbank area results in a considerable increase in conveyance capacity of the outlets during a project flood. The distribution of flow during a project flood would change from 80/20 to about 55/45 with the addition of widening the Wax Lake Outlet overbank. Comparisons of a given plan with and without the wider overbank indicated that the project flood could be reduced by about 1 foot at the end of the Avoca Island levee. Because of the increase in flow out Wax Lake Outlet, the grades for the levees west of Wax Lake Outlet are higher with the wider overbank.

FLOODING EAST OF MORGAN CITY

C.2.49. No Action. The backwater area east of Morgan City (Plate C-48) is bounded by the EABPL, Mississippi River levee, Bayou Lafourche Ridge, Lower Grand River, and Bayou Plaquemine. As discussed earlier, the area is subject to flooding caused by excessive rainfall, high tides in the gulf, and/or backwater from the Lower Atchafalaya River. While the effects of the backwater extend throughout the area, water from the Lower Atchafalaya River does not reach most of the backwater area. Water flowing around the end of the Avoca Island levee is generally confined to the area south of the GIWW and west of a line drawn from Gibson to Lake Mechant. The majority of the water reaching this area is conveyed by the Avoca Island Cutoff Bayou and Bayou Penchant. Littoral currents along the gulf coast are from east to west. These currents cause the bulk of the Atchafalaya River sediments to flow westward to East and West Cote Blanche Bay and Vermilion Bay. The freshwater and sediments flowing east of the Lower Atchafalaya River are primarily confined to the western part of the Terrebonne marshes. The area immediately adjacent to the Lower Atchafalaya River and the Atchafalaya Bay receives the largest quantities of sediment of any area of the Terrebonne marshes. This is evident from an LSU study which indicates this was the only area of the Terrebonne marshes with short term (1972-1978) gains in acreage. The remaining marshes receive freshwater and sediments from the Atchafalaya River in inverse proportion to the distance from the Atchafalaya. The area east of a line drawn from Gibson to Lake Mechant, which includes Lake Penchant and Lake de Cade, do not receive freshwater and sediment from the Atchafalaya River. Marsh loss in this area is occurring because the perfection of the levee system on the west bank of the Mississippi, including the closure of Bayou Lafourche, has severed it from replenishment and nourishment by the Mississippi flow. Marsh loss near the Houma Navigation Canal has been aggravated by saltwater intrusion resulting from the construction of the Houma Canal. Since this area does not receive freshwater or sediment from the Atchafalaya River, the marsh loss trend is expected to continue irrespective of which alternative for the backwater area is selected. As described subsequently, the flooding from rainfall and high tides is related to hydrologic events and should occur with a frequency equal to past occurrences. Flooding caused by backwater is related to the stage in the Lower Atchafalaya River at the end of the Avoca Island levee. Since the development of the Atchafalaya Bay will result in elongation of the river, and resultant escalation of the stage at the end of the levee for a given discharge, flooding caused by backwater will become more frequent and to greater depths as time progresses. The stage-frequency curves (Plates C-49 through C-54) show that the stage at Amelia, with an average return interval of 100 years, is expected to rise from 5.5 to 7.9 feet by the year 2030. Similar increases are expected to occur throughout the backwater area. The bulk of the freshwater and sediment from the Atchafalaya River which is received by the Terrebonne Marshes, is

conveyed by the Avoca Island Cutoff Bayou and Bayou Penchant. Flows leave Bayou Penchant primarily in a southern direction. The area northwest of Bayou Penchant (the Turtle Bay area) receives little sediment from the Atchafalaya River. The high short term acreage loss in this area (noted in the LSU study) was doubtless related to the high freshwater levels experienced successively in 1973, 1974, and 1975. The continuing development of the Atchafalaya Bay will also result in a continuing escalation of stages over these marshes. These higher stages could cause marsh to become open water.

C.2.50. Avoca Island Levee Extension. The Avoca Island levee was built to limit project flood stages east of Morgan City to generally the same as those that occurred in that area in the 1945 flood. However, since construction of the levee and the Bayou Boeuf closure would change the Morgan City-Amelia area from an area affected by headwater flow to one affected by backwater flow, the levee could not exactly reproduce the conditions of the 1945 flood. The 1945 flood stage at Morgan City was 6 feet in the Atchafalaya River and was about 4 feet between Morgan City and Gibson, Louisiana, and between Morgan City and Pierre Pass, Louisiana (see Plate C-48). For the project design flood discharge without the Avoca Island levee, the peak stage east of Morgan City was, in the late 1940's, computed to 4 feet. To achieve the required project flood stage east of Morgan City of 4 feet, the new levee south of Morgan City was alined parallel to the Atchafalaya River, extending a distance about 13 miles south of the city, and terminating at a flowline elevation then estimated at about 7.5 feet. The degree of protection provided by the levee varied with the location and elevation of the protected area. For all lands above elevation 4 feet, complete protection against a project flood was achieved. Lands below 4 feet, while overflowed, would be inundated to lesser depths and for shorter durations. The flood stage reductions would diminish with distance eastward away from Morgan City toward Bayou Lafourche and northward toward Bayou Sorrel lock. Since the original design, deltaic activity below Morgan City has caused the stage at the end of the Avoca Island levee to rise by about 2 feet. To preserve the improvement intended under the original design, extension of the levee by about 2.5 miles is now required to compensate for this rise. As deltaic activity continues, additional extensions totaling 14.5 miles will be required to compensate for the anticipated future increases in stage.

C.2.51. Several alinements for the total extension were considered (Plate 10 of main report). An alinement immediately adjacent to the Lower Atchafalaya River would be accompanied by extensions of the Avoca Island cutoff channel. Alinements following in the existing marsh adjacent to the shoreline or an alinement in the bay adjacent to the shoreline would require some type of navigation structure, since it would be infeasible to extend the Avoca Island cutoff channel around the levee and across the bay for each extension of the levee. The alinement adjacent to the channel and the bay-shore alinement are

shown in Plate 10 of the main report. The location of each extension was determined from projections of the development of the bay and an attempt was made to keep the end of the levee where the stage would be 7.5 feet for project design conditions. It is currently estimated that a total of six extensions will be required at approximately 10-year intervals. Exact timing and distances for future extensions will depend on the rate of development of the bay.

C.2.52. Since the Avoca Island levee extension will reduce the overbank area available for conveyance of a project flood, it will tend to cause higher project flood stages for the Lower Atchafalaya River and the lower end of the EABPL and WABPL. The alinement of the levee immediately adjacent to the channel has the most significant effect by increasing flood heights over those without the extension by up to 2 feet. However, it should be pointed out that project flood flowlines for the TS plan, which contains the Avoca Island levee extension, control of the outlets, and widening the Wax Lake Outlet overbank, are about 1.0 foot lower than the refined 1973 flowline in the Morgan City area and the lower ends of the EABPL and WABPL.

C.2.53. The marsh east of the Avoca Island levee extension depends upon freshwater and sediment from the Lower Atchafalaya River for its nourishment. To prevent the levee extension from increasing saltwater intrusion or marsh subsidence, a freshwater diversion structure is being designed as part of the extension. The structure will divert flow to maintain the present distribution of flow into the west Terrebonne Parish marsh, which is currently estimated to be 4,000 cfs. The structure will divert water into the area until the stage at Amelia, Louisiana, reaches 3.0 feet. At this point the structure will be closed for flood protection. The stage-duration curves indicated that this stage will occur less than 1 percent of the time with the levee extension. Since freshwater diversion will, on the average, be available over 99 percent of the time, there is expected to be no change in the salinity regime due to the project. The freshwater diversion structure is currently designed as eight 10 feet by 15 feet concrete culverts through the existing Avoca Island levee just above the proposed Bayou Shaffer closure. These design criteria, including the size and location of the structure, are subject to refinement during detailed design.

C.2.54. Limited Structural. Alternatives for protection of the backwater area consisted of construction of ring levees. One alternative used two ring levees to protect Morgan City - Amelia and Gibson areas (see Plate C-48 for locations). A second alternative used 28 ring levees to protect various populated areas. Construction of ring levees would provide protection for the ringed area not only from backwater flooding but also headwater and tidal flooding. The degree of protection for hurricane surges was not evaluated for this study. Since the ring levees would have no effect on flood heights outside the rings, design elevations were based on the rating curves

developed for future conditions, no action. The design grades included 2 feet of freeboard. Pumping requirements for drainage in the rings were based on a 24-hour, 25-year frequency storm. The peak sump stage for each subarea was held to 1 foot (elevation +3.0) below the elevation of the improved and populated areas. This restriction provided a safety factor for the most critical areas: that is, areas where flooding would be disastrous to both life and property. This reserve depth would provide a storage volume for protection of the area against additional flooding that might result from rainfall occurring subsequent to the design storm. The alternative consisting of two ring levees utilized a navigation structure in Bayou Chene just below Bayou Boeuf, on Bayou Boeuf just below Lake Palourde, and two on Bayou Black. These structures were to be closed when water elevations began flooding the areas. To provide for drainage of the runoff from the backwater area above Morgan City, a by-pass channel east of Bayou Boeuf would be required. This by-pass channel would have a bottom width of 300 feet with 1V on 3H side slopes and a bottom elevation of minus 20.0 feet NGVD. This channel is equivalent to the existing Bayou Boeuf.

Section 3 - DESIGN AND COST ESTIMATES

GENERAL

C.3.1. No soil borings were made specifically for this study, and no specific geologic field surveys were conducted. However, existing geology publications, general design memorandums, boring data, and other soils information from previous studies were reviewed for a better insight into geologic conditions to be encountered at the proposed and completed project sites within the floodway. A description of surface and subsurface geology is contained in Appendix A.

C.3.2. Design and cost estimates were based on experience from similar projects in the area and were developed to a level adequate to compare the various alternatives. Cost estimates are to an October 1981 price level.

DREDGE 100,000-SF CHANNEL

C.3.3. Development of the main channel through dredging as presented in the 1963 General Design Memorandum required 443,000,000 cy of dredging. Accounting for the quantity that has already been dredged and the enlargement to the natural erosive action of the river, completion of the dredged main channel would require 240,000,000 cy of dredging at an estimated cost of $230,900,000, including 15 percent contingency.

CHANNEL TRAINING

C.3.4. Channel training above Morgan City will require about 29,000,000 cy of dredging along 17.6 miles of channel. The location of dredging and increases in channel area are shown in Table C-3-1 and Plate 6 of the main report. These quantities do not include minor shaping of existing disposal areas to be accomplished by land-based equipment, which may be required during the final construction stages of the training works.

C.3.5. The levee included as part of the control of Wax Lake Outlet would replace some requirements for channel training. For plans in which channel training and control of Wax Lake Outlet were included, the channel training on the right descending bank between miles 101.5 and 104.0 was not required, thereby reducing the dredging quantity for channel training to 27,500,000 cy. The cost estimate for channel training, assuming control of Wax Lake Outlet, is shown in Table C-3-2.

TABLE C-3-1

CHANNEL TRAINING

Location (1963 Mileage)	Descending Bank	Channel Enlargement (sf)
93.7-96.0	Right	6,000
96.8-100.5	Right	12,000
101.0-101.5	Left	4,000
101.5-102.0	Left & Right	8,000
102.8-104.0	Right	4,000
104.0-105.5	Left & Right	10,000 (total)
105.5-107.0	Left	5,000
107.0-107.8	Right	4,000
107.8-108.4	Left & Right	7,000 (total)
108.8-110.4	Left & Right	7,000 (total)
113.5-116.0	Left	8,000

TABLE C-3-2

COST ESTIMATE
Channel Training Above Morgan City

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	6,000 AC		315,000
	Improvements			12,000
	Subtotal			327,000
	Contingencies (25% ±)			82,000
	Acquisition Cost			40,000
	Public Law 91-646			1,000
	Total 01			450,000
09	CHANNELS AND CANALS			
	Hydraulic dredging	27,500,000	1.30/CY	35,750,000
	Contingencies (25% ±)			9,250,000
	Subtotal			45,000,000
	E&D (8%)			3,500,000
	S&A (8%)			3,500,000
	Total 09			52,000,000
	TOTAL			52,450,000

C.3.6. Construction of channel training works will be accomplished by using a hydraulic dredge to pump material from the existing channel bottom areas into adjacent shallow-water bottoms or stream banks. Retaining dikes will be used for the channel training works above Morgan City. Areas selected for dredging will be those with coarser grain sizes, which will maximize natural angles of repose, thereby minimizing the areas needed for disposal. The elevation of the material will be limited to the elevation of the average annual peak stage in the area.

C.3.7. Channel training works on the Lower Atchafalaya River and Wax Lake Outlet are shown on Plate 18 of the main report. The objectives of these works would be provided in phased steps, depending upon natural deltaic activity. No retaining dikes will be used; instead the pumped material will be allowed to spread freely to the angle of repose, estimated to be 1V on 40H. Gaps will be left for pipelines and navigation access. The end result will be an irregular series of relatively low mounds of dredged material, roughly parallel to the

channels, simulating the formation of natural levees. Careful control over placement of the material will be exercised to utilize shallow water bottom adjacent to the channel rather than using existing marsh, whenever possible. In addition, every attempt will be made to avoid filling existing connecting channels. A cost estimate for channel training below Morgan City is presented in Table C-3-3. The selection of areas requiring channel training works was largely based on aerial photographs. Surveys taken for further design may indicate the development of a natural levee to an extent that precludes the requirement for channel training works.

TABLE C-3-3

COST ESTIMATE
Channel Training Below Morgan City

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	1,730 AC		577,000
	Improvements			40,000
	Subtotal			617,000
	Contingencies (25% ±)			154,000
	Acquisition Cost			60,000
	Public Law 91-646			16,000
	Total 01			847,000
09	CHANNELS AND CANALS			
	Hydraulic dredging	4,700,000	1.30/CY	6,110,000
	Closure at Bayou Shaffer (Hyd)	650,000	1.60/CY	1,040,000
	Culverts for Bayou Shaffer			304,000
	Subtotal			7,454,000
	Contingencies (25% ±)			1,849,000
	Subtotal			9,303,000
	E&D (8%)			750,000
	S&A (8%)			750,000
	Total 09			10,803,000
	TOTAL			11,650,000

C.3.8. The cost associated with channel training includes works for the main channel above Morgan City and for the outlets above the existing mouth. The requirement for channel training beyond the existing mouth is a function of the rate and extent of development of the bay, which is highly dependent upon the hydrologic events that occur in the coming years. Since the need for extending the training works will be have to be evaluated as development of the bay occurs, an estimate of cost is not included.

C.3.9. An integral part of the channel training below Morgan City is the closure of Bayou Shaffer (Plate 18 of the main report). This closure would be constructed by hydraulic means using the naturally occurring clay material in the area. No retaining dikes will be constructed for this section. The geometry of the section is based on current bed load transport theory and is larger than that required for stability. A 4-foot diameter pipe will be placed through the section at invert elevation -2.0 to accommodate some low water flows. The crown portion of the hydraulically placed closure section will be shaped after the initial fill has been in place for about 3 years. The shape-up will be in two stages, consisting of an initial dragline shaping and a final dragline shaping about 1 year later. Based on boring data in the area, it is estimated that about 10 feet of settlement can be expected for the closure. The cost estimate for the closure of Bayou Shaffer is included in Table C-3-3.

DISTRIBUTARY REALINEMENT

C.3.10. Realinement of the four major distributaries of the main channel would be accomplished as shown on Plate 7 of the main report, to the dimensions shown in Table C-3-4. Disposal of the dredged material will be in the main channel except for the Atchafalaya River at the Whiskey Bay Pilot Channel realinement for which the material will be placed on land disposal areas. Closure of the existing distribution channels will be accomplished during the final stages of dredging the realined channel by disposal into the existing channel. Channel revetment of each realined channel will be required. The cost estimate for distributary realinement is presented in Table C-3-5.

SEDIMENT TRAPS

C.3.11. Sediment traps would be constructed at each of the four major distributaries near the channel realinements shown on Plate 7 of the main report. Table C-3-6 shows dimensions and initial and maintenance dredging requirements for each sediment trap. Disposal of this dredged material will be on land disposal areas alined parallel to the main channel. The material will be placed to a depth of 20 feet over

TABLE C-3-4

CHANNEL REALINEMENT

Distributary	Length (ft)	Width (ft)	Bottom Elevation (ft NGVD)	Side Slopes	Excavation Required (cy)
Atchafalaya River at WBPC	6,000	1,000 (top)	-15.0	1:3	3,500,000
West Access	8,000	60	-7.0 (bottom)	1:3	350,000
East Fresh-water	13,000	105	-7.0 (bottom)	1:3	800,000
East Access	15,000	60	-7.0 (bottom)	1:3	650,000

TABLE C-3-5

COST ESTIMATE
Channel Realinement

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	752 AC		302,500
	Improvements			23,500
	Subtotal			326,000
	Contingencies (25%±)			82,000
	Acquisition Cost			20,000
	Public Law 91-646			3,000
	Total 01			431,000
09	CHANNELS AND CANALS			
	Channel Realinement			
	Atchafalaya River at WBPC			
	Mob, Demob			115,000
	Clearing, Grubbing	600	1,700/AC	1,020,000
	Retaining Dikes	160,000	3.50/CY	560,000
	Hyd. Excavation	3,500,000	1.40/CY	4,900,000
	Subtotal			6,595,000

TABLE C-3-5 (Continued)

COST ESTIMATE
Channel Realinement

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
	West Access			
	Mob, Demob			115,000
	Clearing, Grubbing	30	1,700/AC	51,000
	Hyd. Excavation	350,000	1.40/CY	490,000
	Subtotal			656,000
	East Freshwater			
	Mob, Demob			115,000
	Clearing, Grubbing	60	1,700/AC	102,000
	Hyd. Excavation	800,000	1.40/CY	1,120,000
	Subtotal			1,337,000
	East Access			
	Mob, Demob			115,000
	Clearing, Grubbing	60	1,700/AC	102,000
	Hyd. Excavation	650,000	1.40/CY	912,000
	Subtotal			1,127,000
	Subtotal 09			9,715,000
	Contingencies (25% ±)			2,326,000
	Subtotal			12,041,000
	E&D (8%)			914,000
	S&A (8%)			914,000
	Total 09			13,869,000
16	BANK STABILIZATION (ACM)			
	Channel Realinement			
	West Access	6,000	LS/SQ	2,900,000
	East Freshwater	8,000	LS/SQ	3,800,000
	East Access	10,000	LS/SQ	4,800,000
	Subtotal			11,500,000
	Contingencies (25% ±)			2,900,000
	Subtotal			14,400,000
	E&D (8%)			1,200,000
	S&A (8%)			1,200,000
	Total 16			16,800,000
	TOTAL			31,100,000

TABLE C-3-6

SEDIMENT TRAPS

Trap	Length (ft)	Width (ft)	Bottom Elevation (ft NGVD)	Initial Excavation (cy)	Annual Maintenance (cy)	Disposal Area (acres)
Atchafalaya River at WBPL	2,500	1,400	-40.0	4,000,000	1,900,000	3,000
West Access	1,000	300	-13.0	180,000	57,000	90
East Freshwater	1,000	400	-13.0	260,000	90,000	150
East Access	1,250	400	-12.0	307,000	80,000	165

the project life. The initial construction of the sediment traps would cost about $12,800,000 including contingencies, E&D, and S&A.

CONTROL OUTLET DISTRIBUTION

C.3.12. The 70/30 control weir will consist of a two-stage stone weir placed at the head of Cypress Island with tie-in levees to the WABPL at Taylor's Point and on the downstream at Stout's Light. The upper tie-in levee from Taylor's Point will be at the same grade as the WABPL with a 20-foot crown, IV on 4H side slopes, and berms as required. This tie-in levee will carry the access road. The lower tie-in levee will start at the weir at elevation +10.1 and tie into the grade of the WABPL at Stout's Light. This levee will also have a 20-foot crown to provide access to the weir, 1V on 4H side slopes, and berms as required. Table C-3-7 contains the cost estimate for the 70/30 control weir and tie-in levees.

C.3.13. Soil boring data in the vicinity of the proposed alinement of the levee indicate recent fat clays of very soft to medium consistency from ground surface to about 50 feet depth, underlain by lean clays and silts to a depth of about 80 feet. The lean clays are underlain by about 40 feet of medium consistency fat clays over substratum sands at a depth of about 120 feet. Settlement of about 2.5 feet is expected for the center of the 70/30 weir, 4.0 feet for the outer sections, and 2.0 feet for the tie-in levees.

C.3.14. The 100/0 control of Wax Lake Outlet would be similar in section to the tie-in levee described previously. The overflow portions would be rip-rapped as required to minimize scour. The cost estimate for the 100/0 control is shown in Table C-3-8.

C.3.15. Control of Wax Lake Outlet to a 80/20 distribution requires the construction of a gated control structure. The control would consist of a control structure and overtopping weir, flanked by an overtopping spoil levee. The control structure would consist of five tainter gated bays, each 60 feet wide. Bottom sill elevation on the control structure would be -10.0. The control structure would be flanked by and overtopping rip-rap weir crest elevation of 5.0 feet, approximately 2,850 feet in length. A continuous spoil levee connecting the closure to the WABPL would remain as discussed in the 30 percent distribution. A 48-inch-thick rip-rap blanket would extend 50 feet upstream and 100 feet downstream of the weir and control structure. This control would cost about $33,100,000 including contingencies E&D and S&A.

TABLE C-3-7

COST ESTIMATE
Outlet Control
70/30 Distribution

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS			
	Easements	300 AC		14,000
	Contingencies (25% ±)			4,000
	Acquisition Cost			12,000
	Total 01			30,000
02	RELOCATIONS			
	CLECO 13.2 KV Powerline			2,100
	Exxon Pipeline 8"ø			22,100
	22"ø			61,400
	Southern Natural Gas	4-4"ø		45,200
		20"ø		55,700
		30"ø		83,600
	Cockrell Oil Co.	4"ø		11,300
		30"ø		83,600
	Subtotal			365,000
	Contingencies (25% ±)			91,000
	Subtotal			456,000
	E&D (6%)			27,000
	S&A (6%)			27,000
	Total 02			510,000
11	LEVEES AND FLOODWALLS			
	Earth Embankment	255,000	2.30/CY	586,500
	Rock Fill	347,000	17.30/TN	6,003,100
	Clearing & Grubbing	300	1,700/AC	510,000
	Subtotal			7,099,600
	Contingencies (25% ±)			1,770,400
	Subtotal			8,870,000
	E&D (8%)			710,000
	S&A (8%)			710,000
	Total 11			10,290,000
	TOTAL			10,830,000

TABLE C-3-8

COST ESTIMATE
Outlet Control
100/0 Distribution

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	470 AC		16,000
	Contingencies (25% ±)			4,000
	Acquisition Cost			16,000
	Total 01			36,000
02	RELOCATIONS			
	CLECO 13.2 KV Powerline			2,100
	Exxon Pipeline Co.	8"ø		21,700
		22"ø		61,400
	Southern Natural Gas	4-4"ø		45,200
		20"ø		55,700
		30"ø		83,600
	Cockrell Oil Co.	4"ø		11,300
	United Gas Co.	30"ø		83,600
	Subtotal			364,600
	Contingencies (25% ±)			91,400
	Subtotal			456,000
	E&D (6%)			27,000
	S&A (6%)			27,000
	Total 02			510,000
11	LEVEES AND FLOODWALLS			
	Cypress Island Levee	1,300,000	2.30/CY	2,990,000
	Clearing & Grubbing	390	1,700/AC	663,000
	Tie-in Levee and Rock Closure			
	Earth Embankment (cast)	325,000	2.30/CY	747,500
	Earth Embankment (hyd)	235,000	3.50/CY	822,500
	Rock Fill	467,000	17.30/TN	8,079,100
	Clearing & Grubbing	60	1,700/AC	102,000
	Subtotal			13,404,100
	Contingencies (25% ±)			3,355,900
	Subtotal 11			16,760,000
	E&D (8%)			1,347,000
	S&A (8%)			1,347,000
	Total 11			19,454,000
	TOTAL			20,000,000

INCREASED SEDIMENT DIVERSION THROUGH WAX LAKE OUTLET

C.3.16. Increased sediment diversion through Wax Lake Outlet would consist of construction of a new channel between the Atchafalaya River and Wax Lake Outlet and closure of the existing connection (Plate 12 of the main report). The new channel would be constructed to maximize sediment diversion. The cost of this feature was estimated to be the same as the 70/30 control weir, with an additional $21,000,000 for construction of the new channel (Table C-3-9).

WIDEN WAX LAKE OUTLET OVERBANK

C.3.17. Widening the Wax Lake Outlet overbank would require construction of 8.0 miles of new levee from near Shadyside, Louisiana, to the GIWW just east of the Wax Lake west pumping station (Plate 9 of the main report). Degradation of the existing 9.3 miles of levee to natural ground will also be required. Relocation of US Highway 90, old US Highway 90, St. Mary Parish Road levee crossing, Southern Pacific railroad, 32 gas and power lines, and the West Calumet floodgate will also be required. Table C-3-10 shows the cost estimate for this feature.

AVOCA ISLAND LEVEE EXTENSION

C.3.18. General. Cost estimates for the bay-shore alinement and the alinement adjacent to the channel are shown in Tables C-3-11 and C-3-12, respectively. Each alinement consists of six extensions over the next 50 years (Table C-3-13). The date for each extension was based on projection of the delta development. The actual construction of each extension is dependent on the actual rate of development of the delta and will have to be evaluated as development takes place.

C.3.19. Soil Conditions. Soil boring data are available for the first extension, which is common to both alinements. The foundation conditions for this extension were derived from these borings. Since data were not available for the remaining extensions and because of the deferred construction timetable, foundation conditions for extensions 2 through 6 were assumed to be the same as that for the first extension.

C.3.20. A generalized soil profile shows the subsurface consists of recent deposits of very soft to medium clay soils, with peat and silt layers. The upper 20 to 30 feet are recent marsh deposits consisting of very soft organic clays and peat, both with very high moisture contents. The recent marsh deposits are underlain by older marsh deposits to a depth of about 60 feet, consisting generally of very soft to medium clays with organic material.

TABLE C-3-9

COST ESTIMATE
Increase Sediment Through WLO

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easement	400 AC		16,000
	Contingencies (25% ±)			4,000
	Acquisition Cost			16,000
	Total 01			36,000
09	CHANNELS AND CANALS			
	Mob & Demob			115,000
	Excavation (hyd)	10,400,000	1.40/CY	14,560,000
	Subtotal			14,675,000
	Contingencies (25% ±)			3,689,000
	Subtotal			18,364,000
	E&D (8%)			1,450,000
	S&A (8%)			1,450,000
	Total 09			21,264,000
	TOTAL			21,300,000

TABLE C-3-10

COST ESTIMATE
Widen Wax Lake Outlet

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	10,345 AC		5,495,000
	Improvements			624,000
	Severence			60,000
	Sugarcane Crop Damage (stubble)			150,000
	Cemetery Relocation			12,000
	Subtotal			6,341,000
	Contingencies (25% ±)			1,585,000
	Acquisition Cost			300,000
	Public Law 91-646			322,000
	Total 01			8,548,000
02	RELOCATIONS			
	Westside Approach US Hwy 90, 4-lane			258,000
	US Hwy 90 Elevated 4-lane			19,726,000
	Old US Hwy 90 Levee Crossing			86,000
	St. Mary Parish Road Levee Crossing			86,000
	Southern Pacific Elevated Track			7,105,000
	Southern Pacific Approaches			73,000
	Southern Pacific Removal of Old Track			66,000
	Southern Pacific R/W			451,000
	Trunkline Gas Co. 2-30"ø			412,000
	Texas Gas Transmission Co. 2-20"ø			275,000
	LA Intrastate Gas 2-8"ø			109,000
	Promix Corp 2-8"ø			109,000
	Wanda Petroleum 4-8"ø			218,000
	Columbia Gulf 2-20"ø			275,000
	2-30"ø			412,000
	Southern Natural Gas Co. 6"ø			55,000
	Degrade WABPL 6"ø			29,000
	Michigan - Wisconsin Pipeline Co. 20"ø			183,000
	Degrade WABPL 20"ø			92,000
	Placid Oil Co. 6"ø			55,000
	Degrade WABPL 6"ø			29,000
	4 - 34.5 KV Powerlines			34,000
	2 - 100 pair telephone cables			9,000
	Southern Natural Gas Co. 2-12"ø			83,000
	United Gas Pipeline Co. 2-26"ø			179,000
	Subtotal			30,409,000

TABLE C-3-10 (Continued)

COST ESTIMATE
Widen Wax Lake Outlet

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
	Contingencies (25% ±)			7,601,000
	Subtotal			38,010,000
	E&D (6%)			2,280,000
	S&A (6%)			2,280,000
	Total 02			42,570,000
11	LEVEES AND FLOODWALLS			
	Realined levee	2,500,000	3.50/CY	8,750,000
	Clearing & Grubbing	550	1,700/AC	935,000
	Degrade levee	1,714,000	1.70/CY	2,913,800
	Clearing & Grubbing	780	1,700/AC	1,326,000
	West Calumet Floodgate			13,200,000
	Subtotal			27,124,800
	Contingencies (25% ±)			6,785,200
	Subtotal			33,910,000
	E&D (8%)			2,736,000
	S&A (8%)			2,736,000
	Total 11			39,382,000
	TOTAL			90,500,000

TABLE C-3-11

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Station 680+00 to Station 1714+00
Bay-Shore Alinement

Reach 1 ------- Station 680+00 - 817+00
Reach 2 ------- Station 817+00 - 997+00
Reach 3 ------- Station 997+00 - 1267+00
Reach 4 ------- Station 1267+00 - 1420+00
Reach 5 ------- Station 1420+00 - 1568+00
Reach 6 ------- Station 1568+00 - 1714+00

SUMMARY

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	132,000
	Contingencies (25% ±)	33,000
	Acquisition Cost	12,000
	Total 01	177,000
02	RELOCATIONS	4,356,000
	Contingencies (25% ±)	1,087,000
	Total 02	5,443,000
06	FISH AND WILDLIFE FACILITIES	86,051,000
	Contingencies (25% ±)	21,519,000
	Total 15	107,570,000
11	LEVEES AND FLOODWALLS	177,173,000
	Contingencies (25% ±)	44,297,000
	Total 11	221,470,000
30	ENGINEERING AND DESIGN	26,820,000
31	SUPERVISION AND ADMINISTRATION	26,820,000
	TOTAL	388,300,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
1986 Start	1st Lift	6,998,000
1988 End	Retaining Dikes	1,220,000
1st Contract	Waste Dikes	233,000
1st Reach	Relocations	2,334,000
	Lands and Damages (660 acres)	132,000
	Waste Excavation	4,535,000
	Closure of AICO	5,444,000
	Diversion Structure	5,137,000
	Subtotal	26,033,000
	Contingencies (25% ±)	6,505,000
	Subtotal	32,538,000
	E&D/S&A (16%)	5,200,000
	Acquisition Cost	12,000
	Total	37,750,000
1990 Start	1st Lift	8,841,000
1993 End	Dikes	1,233,000
1st Contract	Waste Dikes	301,000
2nd Reach	Waste Excavation	5,977,000
	Lands and Damages (887 acres)	0
	Relocations	297,000
	Inflatable dam	80,914,000
	Subtotal	97,563,000
	Contingencies (25% ±)	24,387,000
	Subtotal	121,950,000
	E&D/S&A (16%)	19,550,000
	Total	141,500,000
1991 Start	2nd Lift	6,085,000
1992 End	Retaining Dikes	686,000
2nd Contract	Subtotal	6,771,000
1st Reach	Contingencies (25% ±)	1,699,000
	Subtotal	8,470,000
	E&D/S&A (16%)	1,350,000
	Total	9,820,000
1995 Start	3rd Lift	6,239,000
1996 End	Retaining Dikes	546,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
3rd Contract	2nd Lift	8,059,000
1st Reach	Retaining Dikes	908,000
2nd Contract	Subtotal	15,752,000
2nd Reach	Contingencies (25% ±)	3,938,000
	Subtotal	19,690,000
	E&D/S&A (16%)	3,150,000
	Total	22,840,000
1999 Start	3rd Lift	4,633,000
2003 End	Retaining Dikes	594,000
3rd Contract	1st Lift	13,242,000
2nd Reach	Dikes	1,846,000
1st Contract	Waste Dikes	450,000
3rd Reach	Waste Excavation	8,952,000
	Lands & Damages (1,333 acres)	0
	Subtotal	29,717,000
	Contingencies (25% ±)	7,423,000
	Subtotal	37,140,000
	E&D/S&A (16%)	5,950,000
	Total	43,090,000
2001 Start	Shape-Up	332,000
2002 End	Fert/Seed	69,000
4th Contract	Subtotal	401,000
1st Reach	Contingencies (25% ±)	100,000
	Subtotal	501,000
	E&D/S&A (16%)	80,000
	Total	581,000
2006 Start	Shape-Up	443,000
2007 End	Fert/Seed	73,000
4th Contract	2nd Lift	12,070,000
2nd Reach	Retaining Dikes	1,362,000
2nd Contract	Subtotal	13,948,000
3rd Reach	Contingencies (25% ±)	3,452,000
	Subtotal	17,400,000
	E&D/S&A (16%)	2,800,000
	Total	20,200,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
2010 Start	3rd Lift	6,939,000
2014 End	Retaining Dikes	890,000
3rd Contract	1st Lift	7,493,000
3rd Reach	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
4th Reach	Waste Excavation	5,066,000
	Lands and Damages (754 acres)	0
	Relocations	1,725,000
	Subtotal	23,413,000
	Contingencies (25% ±)	5,837,000
	Subtotal	29,250,000
	E&D/S&A (16%)	4,700,000
	Total	33,950,000
2016 Start	Shape-Up	664,000
2017 End	Fert/Seed	109,000
4th Contract	2nd Lift	6,830,000
3rd Reach	Retaining Dikes	771,000
2nd Contract	Subtotal	8,374,000
4th Reach	Contingencies (25% ±)	2,126,000
	Subtotal	10,500,000
	E&D/S&A (16%)	1,700,000
	Total	12,200,000
2020 Start	3rd Lift	3,926,000
2024 End	Retaining Dikes	504,000
3rd Contract	1st Lift	7,250,000
4th Reach	Dikes	745,000
1st Contract	Waste Dikes	247,000
5th Reach	Waste Excavation	4,900,000
	Lands and Damages (704 acres)	0
	Subtotal	17,572,000
	Contingencies (25% ±)	4,428,000
	Subtotal	22,000,000
	E&D/S&A (16%)	3,500,000
	Total	25,500,000
2026 Start	Shape-Up	139,000
2027 End	Fert/Seed	54,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
4th Contract	2nd Lift	6,603,000
4th Reach	Dikes	487,000
2nd Contract	Subtotal	7,283,000
5th Reach	Contingencies (25% ±)	1,817,000
	Subtotal	9,100,000
	E&D/S&A (16%)	1,500,000
	Total	10,600,000
2030 Start	Shape-Up	549,000
2033 End	Fert/Seed	51,000
3rd Contract	1st Lift	7,151,000
5th Reach	Retaining Dikes	736,000
1st Contract	Waste Dikes	244,000
6th Reach	Waste Excavation	4,834,000
	Lands and Damages	0
	Subtotal	13,565,000
	Contingencies (25% ±)	3,435,000
	Subtotal	17,000,000
	E&D/S&A (16%)	2,700,000
	Total	19,700,000
2036 Start	1st Lift	6,514,000
2037 End	Retaining Dikes	480,000
2nd Contract	Subtotal	6,994,000
6th Reach	Contingencies (25% ±)	1,706,000
	Subtotal	8,700,000
	E&D/S&A (16%)	1,400,000
	Total	10,100,000
2040 Start	Shape-Up	283,000
2041 End	Fert/Seed	43,000
3rd Contract	Subtotal	326,000
6th Reach	Contingencies (25% ±)	83,000
	Subtotal	409,000
	E&D/S&A (16%)	60,000
	Total	469,000
	TOTAL COST	388,300,000

TABLE C-3-12

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Station 680+00 to Station 1580+00
Adjacent to Channel Alinement

Reach 1 ------- Station 680+00 - 817+00
Reach 2 ------- Station 817+00 - 970+00
Reach 3 ------- Station 970+00 - 1123+00
Reach 4 ------- Station 1123+00 - 1276+00
Reach 5 ------- Station 1276+00 - 1429+00
Reach 6 ------- Station 1429+00 - 1580+00

SUMMARY

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	132,000
	Contingencies (25% ±)	33,000
	Acquisition Cost	12,000
	Total 01	177,000
02	RELOCATIONS	3,225,000
	Contingencies (25% ±)	804,000
	Total 02	4,029,000
06	FISH AND WILDLIFE FACILITIES	5,137,000
	Contingencies (25% ±)	1,283,000
	Total 15	6,420,000
11	LEVEES AND FLOODWALLS	178,876,000
	Contingencies (25% ±)	44,714,000
	Total 11	223,590,000
30	ENGINEERING AND DESIGN	18,732,000
31	SUPERVISION AND ADMINISTRATION	18,732,000
	TOTAL	271,680,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
1986 Start	1st Lift	6,998,000
1988 End	Retaining Dikes	1,220,000
1st Contract	Waste Dikes	233,000
1st Reach	Relocations	2,334,000
	Lands and Damages (660 acres)	132,000
	Waste Excavation	4,535,000
	Diversion Structure	5,137,000
	Closure of AICO	5,444,000
	Subtotal	26,033,000
	Contingencies (25% ±)	6,505,000
	Subtotal	32,538,000
	E&D (8%)	2,600,000
	S&A (8%)	2,600,000
	Acquisition Cost	12,000
	Total	37,750,000
1990 Start	1st Lift	6,811,000
1993 End	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
2nd Reach	Waste Excavation	5,066,000
	Lands and Damages (752 acres)	0
	Relocations	297,000
	Closure	6,807,000
	Subtotal	20,281,000
	Contingencies (25% ±)	5,069,000
	Subtotal	25,350,000
	E&D/S&A (16%)	4,060,000
	Total	29,410,000
1991 Start	2nd Lift	5,482,000
1992 End	Retaining Dikes	686,000
2nd Contract	Subtotal	6,168,000
1st Reach	Contingencies (25% ±)	1,542,000
	Subtotal	7,710,000
	E&D/S&A (16%)	1,230,000
	Total	8,940,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
1995 Start	3rd Lift	5,621,000
1996 End	Retaining Dikes	546,000
3rd Contract	2nd Lift	6,209,000
1st Reach	Retaining Dikes	770,000
2nd Contract	Subtotal	13,146,000
2nd Reach	Contingencies (25% ±)	3,284,000
	Subtotal	16,430,000
	E&D/S&A (16%)	2,630,000
	Total	19,060,000
1999 Start	3rd Lift	3,569,000
2003 End	Retaining Dikes	504,000
3rd Contract	1st Lift	6,811,000
2nd Reach	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
3rd Reach	Waste Excavation	5,066,000
	Lands and Damages (754 acres)	0
	Relocations	297,000
	Closure	6,805,000
	Subtotal	24,352,000
	Contingencies (25% ±)	6,088,000
	Subtotal	30,440,000
	E&D/S&A (16%)	4,870,000
	Total	35,310,000
2001 Start	Shape-Up	332,000
2002 End	Fert/Seed	69,000
4th Contract	Subtotal	401,000
1st Reach	Contingencies (25% ±)	100,000
	Subtotal	501,000
	E&D/S&A (16%)	79,000
	Total	580,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
2006 Start	Shape-Up	376,000
2007 End	Fert/Seed	62,000
4th Contract	2nd Lift	6,209,000
2nd Reach	Retaining Dikes	770,000
2nd Contract	Subtotal	7,417,000
3rd Reach	Contingencies (25% ±)	1,853,000
	Subtotal	9,270,000
	E&D/S&A (16%)	1,480,000
	Total	10,750,000
2010 Start	3rd Lift	3,569,000
2014 End	Retaining Dikes	504,000
3rd Contract	1st Lift	6,811,000
3rd Reach	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
4th Reach	Waste Excavation	5,066,000
	Lands and Damages (732 acres)	0
	Relocations	297,000
	Closure	6,805,000
	Subtotal	24,352,000
	Contingencies (25%±)	6,088,000
	Subtotal	30,440,000
	E&D/S&A (16%)	4,870,000
	Total	35,310,000
2016 Start	Shape-Up	376,000
2017 End	Fert/Seed	62,000
4th Contract	2nd Lift	6,209,000
3rd Reach	Retaining Dikes	770,000
2nd Contract	Subtotal	7,417,000
4th Reach	Contingencies (25%±)	1,853,000
	Subtotal	9,270,000
	E&D/S&A (16%)	1,480,000
	Total	10,750,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
2020 Start	3rd Lift	3,569,000
2024 End	Retaining Dikes	504,000
3rd Contract	1st Lift	6,814,000
4th Reach	Dikes	770,000
1st Contract	Waste Dikes	255,000
5th Reach	Waste Excavation	5,066,000
	Lands and Damages (728 acres)	0
	Closure	6,805,000
	Subtotal	23,783,000
	Contingencies (25% ±)	5,947,000
	Subtotal	29,730,000
	E&D/S&A (16%)	4,760,000
	Total	34,490,000
2026 Start	Shape-Up	139,000
2027 End	Fert/Seed	54,000
4th Contract	2nd Lift	6,205,000
4th Reach	Dikes	504,000
2nd Contract	Subtotal	6,902,000
5th Reach	Contingencies (25% ±)	1,728,000
	Subtotal	8,630,000
	E&D/S&A (16%)	1,380,000
	Total	10,010,000
2030 Start	Shape-Up	568,000
2033 End	Fert/Seed	53,000
3rd Contract	1st Lift	6,723,000
5th Reach	Retaining Dikes	761,000
1st Contract	Waste Dikes	252,000
6th Reach	Waste Excavation	4,999,000
	Closure	6,805,000
	Lands and Damages (695 acres)	0
	Subtotal	20,161,000
	Contingencies (25% ±)	5,039,000
	Subtotal	25,200,000
	E&D/S&A (16%)	4,030,000
	Total	29,230,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
2036 Start	1st Lift	6,124,000
2037 End	Dikes (Retaining)	496,000
2nd Contract	Subtotal	6,620,000
6th Reach	Contingencies (25% ±)	1,655,000
	Subtotal	8,275,000
	E&D/S&A (16%)	1,325,000
	Total	9,600,000
2040 Start	Shape-Up	292,000
2041 End	Fert/Seed	45,000
3rd Contract	Subtotal	337,000
6th Reach	Contingencies (25% ±)	83,000
	Subtotal	420,000
	E&D/S&A (16%)	70,000
	Total	490,000
	TOTAL COST	271,680,000

TABLE C-3-13

AVOCA ISLAND LEVEE EXTENSION

Extension Number	Year of 1st Lift	Adjacent to Channel Levee Station Begin	Adjacent to Channel Levee Station End	Bay Shore Levee Station Begin	Bay Shore Levee Station End
1	1986	680+00	817+00	680+00	817+00
2	1990	817+00	970+00	817+00	997+00
3	1999	970+00	1123+00	997+00	1267+00
4	2010	1123+00	1267+00	1267+00	1420+00
5	2020	1267+00	1429+00	1420+00	1568+00
6	2030	1429+00	1580+00	1568+00	1714+00

C.3.21. Methods of Construction. The levee will be built by stage construction over a period of several years. The hydraulic clay fill will be obtained from the channel relocation area and will be pumped in three lifts with approximately 3-year intervals between succesive lifts, followed by an initial and final shape-up. The first lift will have a crown elevation of 10.0 with 1V on 40H slopes tieing into the retention dikes at an elevation not higher than 3 feet below the dike crown. Approximately 3 years after the final pumping, the levee will be shaped by dragline. One year after initial shape-up, a final dragline shape-up with an allowable overbuild for future settlement will be accomplished.

C.3.22. The dikes will be constructed with cast fill from interior borrow pits. Sufficient material will be stockpiled in the form of a berm adjacent to the riverside (west) levee retention dike to permit raising of the dike to compensate for settlement during the first lift construction. Pipeline canals and natural bayous will be closed with clay-faced shell closures. Before any levee work begins, the pipelines will be relocated on temporary pile bents to conform to the final levee section. After completion of the levee, all piling and supports must be either driven down or broken off to a minimum depth of 8 feet below the surface of the theoretical design section. Openings will be provided in the riverside retention dike and in the landside channel waste dike on about 1,000-foot centers to allow the hydraulic effluent to exit. The hydraulic effluent from the first lift section will be allowed to flow over the marsh into the Lower Atchafalaya River, thereby enhancing the marsh. The openings through the waste dike will allow the hydraulic effluent to run back into the channel being constructed. The dike openings will be constructed using standard variable-head spill boxes.

C.3.23. The channel relocation-borrow fill will be stripped and all material above elevation minus 15.0 will be wasted. The waste material will be placed in an area adjacent to the first lift levee fill. The channel side waste dike is to be constructed with cast fill from an interior borrow pit. A working berm of 40 feet from the dike toe to the top of cut will be maintained. The back channel waste dike will also be used as the landside retention dike for the first lift levee construction. The hydraulic clay borrow will be taken from material below elevation minus 15.0.

C.3.24. Stability Analysis. Stability of the hydraulic fill first lift sections were determined using cross sections and (Q) sheer strengths representative of the existing conditions along the levee alinement. The maximum allowable first lift section was developed, based on the method of planes and a minimum safety factor of 1.30. The levee retention dikes were located so that they would form the berm toe for the final levee section. The retention dikes were designed for minimum safety factors of 1.20 for the temporary condition of interior borrow with no hydraulic levee fill in place, and 1.30 for

the condition of hydraulic levee fill placed within 3 feet of the dike crown and hydraulic effluent to the top of the dikes.

C.3.25. Shell Closure Retention Dikes. Two types of shell closure dikes, designed to be used across bayou and oil company canals, have the following range of depths: elevation 0 to minus 3; minus 3 to minus 6; and minus 6 to minus 9. The dikes will be used along the riverside (west) dike alinement. The landside (east) dike, which will have fill on both sides, will be made up of shell with clay facing on both sides. The dike section will be formed by constructing the eastern (fill side) symmetrically about the dike centerline. The closure dikes were designed for a minimum safety factor of 1.30, considering hydraulic fill to within 3 feet of the top of dike. Check analyses considering hydraulic effluent to the top of the dikes were made and resulted in no significant change in safety factors. Stability analyses were also performed with no fill in place for an assumed failure in the fill area.

C.3.26. Channel Waste Dike. The channel waste dike was designed for a minimum safety factor of 1.30 within itself and a minimum safety factor of 1.50 into the channel relocation borrow pit. Designs were based on the condition of spoil to within 3 feet of the top of the dikes and hydraulic effluent to the top of the dikes. A 40-foot minimum work area was maintained between the top of cut and toe of dike.

C.3.27. Navigation channel. The channel section will be constructed with 1V on 3.5H side slopes to elevation minus 20.0 (with 2 feet of future maintenance depth). Stability analyses of the channel slopes were performed for a minimum safety factor of 1.50. The channel for the alinement adjacent to the river will be constructed incident to the levee construction (as borrow), and no additional costs are anticipated.

C.3.28. The bay-shore alinement will require some type of navigation structure because it would be impractical to relocate the navigation channel around the end of the levee and across the eastern bay to the Lower Atchafalaya River for each extension. Since navigation in the Avoca Island channel requires 400 feet of width, the structure is beyond the scope of a conventional structure. The estimate shown in Table C-3-11, includes a cost for an inflatable dam across the navigation channel after the first extension. The inflatable dam consists of a rubberized fabric, which is anchored to the channel bottom. When the stages in the Lower Atchafalay River begin to cause backwater problems, the dam would be inflated with water, creating a barrier equal to the levee in protection.

C.3.29. While inflatable dams have been used in various locations around the world, little information has been available to determine their workability for this project. Extensive investigations will have to be undertaken prior to final determination of its use in the

Avoca Island levee extension. The cost estimate, shown in Table C-3-11, for the dam was based on assuming construction of the dam would require dewatering the construction site and excavation of a bypass channel.

C.3.30. Freshwater Diversion Structure. The freshwater diversion structure will be pile supported and constructed in the dry behind cofferdams. The structure is currently designed as eight 10- by 15-foot concrete culverts through the existing Avoca Island levee. The inflow and outflow channels will be constructed after the structure is complete, backfilled, and with the erosion protection in place. Cost for the structure is shown in Tables C-3-11 and C-3-12.

C.3.31. Floodwall Construction. Consideration was given to utilizing floodwall construction to produce favorable economics in constructing the Avoca Island levee extension. The first attempt consisted of an I-wall driven into a levee with a crown elevation low enough to utilize cast-fill construction. A slope stability analysis resulted in a levee cross section with small berms and borrow areas close enough to utilize castfill construction without double handling the fill material. However, cantilever retaining wall analyses indicate required sheetpile lengths of 82.5 and 86.5 feet for the two reaches.

C.3.32. For a second design attempt, a sheetpile length of 40 feet was determined to be the maximum which might be driven in the existing terrain. Preliminary cantilever retaining wall analyses indicate the required crown elevations of the levees would require large berms and would extend the safe limits of the available borrow areas beyond the distance which could be singly handled by cast-fill construction methods. It is anticipated that hydraulic-construction will be utilized and the first lift sections would be identical to that used for the all-earthen levee. Two lifts are anticipated, 3 years apart, with a shape-up 3 years after the second lift. Cost estimates indicated use of an I-wall would cost about $81,600,000 more than an all-earthen levee for the six extensions.

LIMITED STRUCTURAL

C.3.33. Two alternatives utilizing ring levees in the backwater area were investigated. The alternative consisted of two ring levees around the Morgan City-Amelia area and the Bayou Black-Gibson area. These two rings utilized inflatable dams in Bayou Boeuf and Bayou Black. The total construction costs for the two rings is $420,000,000. The second alternative consisted of 28 ring levees throughout the area. Location of the rings avoided the use of navigation structures. The total construction cost for the 28-ring levee alternative is $391,000,000.

C.3.34. The estimate for the ring levees alternative includes those first costs for levee, floodwall and pumping station construction, lands and damages, and relocations. Floodproofing of structures outside the ring levees is not included. The cost includes collapsible floodwalls in the industrial areas of Morgan City and Amelia. Use of a collapsible floodwall for flood protection is not desirable from an operational standpoint. Since this is a survey scope estimate, a complete investigation of the details of such a wall has not been made. However, there is concern of its practicality in two particular areas. In its down position the wall will be crossed by heavy industrial traffic and may be subject to damages and, therefore, not operable when it is needed. To maintain the appropriate freeboard, it would be necessary to raise the floodwalls prior to a stage of 3 feet. Since stages in this area are affected by tides, there would be little or no advance notice as to the requirement to raise the floodwall; therefore, it will be necessary to construct a wall which can be raised very quickly.

MANAGEMENT UNITS

C.3.35. The cost estimates presented in Tables C-3-14 through C-3-18 are for the five management units being recommended for further consideration. The levee costs are based on levees with 1V on 3H side slopes constructed by adjacent casting. Existing ground surface elevations in the area of the proposed levee were extracted from contour maps and hydrographic surveys. The height of the levees were determined from the average annual peak flowline at the location of the proposed levee.

C.3.36. Construction of levees for the management units would be limited to a portion of the total circumference of the units, since the existing ground for the remaining portions equals or exceeds the levee height requirement. For the Flat Lake unit levee, construction would take place only along the southern and southwestern boundaries. Construction for Buffalo Cove would take place along the southern half of the western boundary and closing at low spots for the remaining boundary. Beau Bayou's construction would primarily be closing at low spots in its existing levees. No initial levee construction is anticipated for Henderson and Cocodrie Swamps.

C.3.37. The inlet for the Henderson Unit would be the proposed Courtableau freshwater structure and the existing drainage structures. Extensive channel work would be required for the freshwater structure. The costs for the channel work are presented in Table C-3-14, and the freshwater structure costs are shown in Table C-3-19.

TABLE C-3-14

COST ESTIMATE
Henderson Management Unit

Cost Account Number	Description	Quantity	Estimated Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Mob, Demob			115,000
	Clearing, Grubbing	200	1,400/AC	280,000
	Dike Construction	190,000	1.20/CY	228,000
	Excavation	5,000,000	1.40/CY	7,000,000
	Subtotal			7,623,000
	Contingencies (25% ±)			1,977,000
	Subtotal			9,600,000
	E&D (8%)			750,000
	S&A (8%)			750,000
	Total 09			11,100,000
	TOTAL			11,100,000

TABLE C-3-15

COST ESTIMATE
Buffalo Cove Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Improve Aligator Bayou			
	Mob, Demob			46,000
	Clearing, Grubbing	70	1,400/AC	98,000
	Excavation (cast)	350,000	1.40/CY	490,000
	Inlet and Outlet Channel			
	Mob, Demob			60,000
	Excavation (cast)	180,000	1.40/CY	252,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			1,257,400
	Contingencies (25% ±)			302,600
	Subtotal			1,560,000
	E&D (8%)			120,000
	S&A (8%)			120,000
	Total 09			1,800,000
11	LEVEES AND FLOODWALLS			
	Embankment	113,000	2.10/CY	271,200
	Contingencies (25% ±)			64,800
	Subtotal			336,000
	E&D (8%)			27,000
	S&A (8%)			27,000
	Total 11			390,000
	TOTAL			2,190,000

TABLE C-3-16

COST ESTIMATE
Beau Bayou Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Inlet from Little Devil Cut			
	Mob, Demob			46,000
	Clearing, Grubbing	80	1,400/AC	112,000
	Excavation	600,000	1.40/AC	840,000
	Outlet			
	Mob, Demob			60,000
	Excavation (cast)	90,000	1.40/CY	126,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			1,495,400
	Contingencies (25% ±)			354,600
	Subtotal			1,850,000
	E&D (8%)			150,000
	S&A (8%)			150,000
	Total 09			2,150,000
11	LEVEES AND FLOODWALLS			
	Embankment	3,000	2.40/CY	7,200
	Contingencies (25% ±)			1,700
	Subtotal			8,900
	E&D (8%)			550
	S&A (8%)			550
	Total 11			10,000
	TOTAL			2,160,000

TABLE C-3-17

COST ESTIMATE
Cocodrie Swamp Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Improvement to Bayou LaRose			
	Mob, Demob			46,000
	Clearing, Grubbing	42	1,400/AC	58,800
	Excavation (cast)	300,000	1.40/CY	420,000
	Outlet			
	Mob, Demob			60,000
	Excavation (cast)	90,000	1.40/CY	126,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			1,022,200
	Contingencies (25% ±)			257,800
	Subtotal			1,280,000
	E&D (8%)			100,000
	S&A (8%)			100,000
	Total 09			1,480,000
	TOTAL			1,480,000

TABLE C-3-18

COST ESTIMATE
Flat Lake Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
02	RELOCATIONS			
	Mobil Pipeline 8"ϕ			21,000
	Dixie Pipelie 6"ϕ			16,000
	Subtotal			37,000
	Contingencies (25% ±)			8,400
	Subtotal			45,400
	E&D (6%)			2,300
	S&A (6%)			2,300
	Total 02			50,000
09	CHANNELS AND CANALS			
	Channel Excavation			
	Mob, Demob			115,000
	Clearing, Grubbing	130	1,400/AC	182,000
	Dike Construction	120,000	1.20/CY	144,000
	Excavation	2,000,000	1.40/CY	2,800,000
	Inlet and Outlet			
	Mob, Demob			60,000
	Excavation (cast)	180,000	1.40/CY	252,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			3,864,400
	Contingencies (25% ±)			935,600
	Subtotal			4,800,000
	E&D (8%)			400,000
	S&A (8%)			400,000
	Total 09			5,600,000
11	LEVEES AND FLOODWALLS			
	Embankment	330,000	2.10/CY	792,000
	Contingencies (25% ±)			198,000
	Subtotal			990,000
	E&D (8%)			80,000
	S&A (8%)			80,000
	Total 11			1,150,000
	TOTAL			6,800,000

TABLE C-3-19

COST ESTIMATE
Freshwater Diversion Structure

Cost Account Number	Description	Estimated Quantity	Estimated Amount ($)
01	LANDS AND DAMAGES		
	Perpetual Channel, Borrow and Levee		
	Homesites	7 AC	24,500
	High Woodland	442 AC	618,800
	Improvements		121,800
	Subtotal		765,100
	Contingencies (25% ±)		190,900
	PL 91-646		105,000
	Acquisition Cost		28,000
	Total 01		1,089,000
06	FISH AND WILDLIFE FACILITIES		
	Henderson		2,415,000
	Sherburne		2,415,000
	Subtotal		4,830,000
	Contingencies (25% ±)		1,190,000
	Subtotal		6,020,000
	E&D (8%)		500,000
	S&A (8%)		500,000
	Total 15		7,020,000
	TOTAL		8,109,000

C.3.38. Construction of a new inlet for Buffalo Cove from Aligator Bayou would be required. The inlet is presently designed as a 400-foot-wide broad-crested weir. Rip-rap would be required upstream and downstream of the weir. The outlet to Lake Fausse Point cut is a rip-rap weir 40 feet wide. Cost estimates for the inlet and outlet are presented in Table C-3-15.

C.3.39. The remaining units would require construction of inlets and outlets. These estimates are included in Tables C-3-16 through C-3-18.

LEVEES, FLOODWALLS, LOCKS, AND PUMPING PLANTS

C.3.40. Costs estimates for levees, floodwalls, locks, and pumping plants are dependent on the flowline; therefore, they vary with each alternative plan. Cost estimates for future without-project, NED, EQ, and the recommended plans are contained in Tables C-3-20 through C-3-23. Estimates for levee construction were based on past experience in building these levees. The estimate considers the requirement for changing from an all-earthen levee to a floodwall because of the height of the flowline.

C.3.41. The estimates shown in Tables C-3-20 through C-3-23 use an estimated start date of October 1985 for the proposed new flowline and are adjusted to an October 1981 price level. Construction of levees and floodwalls scheduled for award through FY 1984 are not included in these tables but are shown in Table C-3-24 (used October 1979 PB-3 and schedule from 20 November 1979 PB-2A).

C.3.42. Table C-3-25 summarizes the features contained in the NED, EQ, TS, and recommended plans.

TABLE C-3-20

COST ESTIMATE
Future Without
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Easements	7,166,000
	Improvements	348,000
	Subtotal	7,514,000
	Contingencies (25%±)	1,880,000
	Acquisition Cost	1,104,000
	Resettlement	102,000
	Total 01	10,600,000
02	RELOCATIONS	18,030,000
	Contingencies (25% ±)	4,570,000
	Subtotal	22,600,000
	E&D (6%)	1,350,000
	S&A (6%)	1,350,000
	Total 02	25,300,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,788,000
	Subtotal	19,545,000
	Contingencies (25% ±)	4,855,000
	Subtotal	24,400,000
	E&D (8%)	1,950,000
	S&A (8%)	1,950,000
	Total 05	28,300,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	380,670,000
	Service Roads (429 miles)	5,440,000
	East and West Calumet Floodgate	15,640,000
	Charenton Floodgate	10,780,000
	Wax Lake East Draining Structure	1,260,000
	Wax Lake West Draining Structure	1,010,000
	Subtotal	414,800,000
	Contingencies (25%±)	103,850,000
	Subtotal	518,650,000
	E&D (8%)	41,500,000
	S&A (8%)	41,500,000
	Total 11	601,650,000

TABLE C-3-20 (Continued)

COST ESTIMATE
Future Without
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	500,000
	Wax Lake West	347,000
	Ellerslie	58,000
	North Bend	132,000
	Maryland	132,000
	Centerville	132,000
	Bayou Yokely and Enlargement	600,000
	Franklin	113,000
	Gordy	162,000
	Subtotal	2,176,000
	Contingencies (25% ±)	544,000
	Subtotal	2,720,000
	E&D (8%)	215,000
	S&A (8%)	215,000
	Total 13	3,150,000
	TOTAL	669,000,000

TABLE C-3-21

COST ESTIMATE
NED Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Enlargement of Existing Levees and Floodwalls	7,005,000
	Channel Training Above Morgan City	327,000
	Channel Realinement	326,000
	Outlet Control (100/0)	16,000
	Widen Wax Lake Outlet	6,341,000
	Avoca Island Levee Extension (Adjacent to Channel)	132,000
	Channel Training Below Morgan City	617,000
	Subtotal	14,764,000
	Contingencies (25%±)	3,687,000
	Acquisition Cost	1,528,000
	Resettlement	444,000
	Total 01	20,423,000
02	RELOCATIONS	
	Enlargement of Existing Levees and Floodwalls	15,617,000
	Outlet Control (100/0)	365,000
	Widen Wax Lake Outlet	30,409,000
	Avoca Island Levee Extension	3,225,000
	Subtotal	49,616,000
	Contingencies (25% ±)	12,419,000
	Subtotal	62,035,000
	E&D (6%)	3,740,000
	S&A (6%)	3,740,000
	Total 02	69,515,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,420,000
	Subtotal	19,177,000
	Contingencies (25% ±)	4,783,000
	Subtotal	23,960,000
	E&D (8%)	1,920,000
	S&A (8%)	1,920,000
	Total 05	27,800,000

TABLE C-3-21 (Continued)

COST ESTIMATE
NED Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
06	FISH AND WILDLIFE FACILITIES	
	Avoca Island Levee Extension	5,137,000
	Contingencies (25% ±)	1,283,000
	Subtotal	6,420,000
	E&D (8%)	510,000
	S&A (8%)	510,000
	Total 06	7,440,000
09	CHANNELS AND CANALS	
	Channel Training Above Morgan City	35,750,000
	Channel Realinement	9,715,000
	Channel Training Below Morgan City	7,454,000
	Subtotal	52,919,000
	Contingencies (25% ±)	13,425,000
	Subtotal	66,344,000
	E&D (8%)	5,164,000
	S&A (8%)	5,164,000
	Total 09	76,672,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	255,128,000
	Service Roads (429 miles)	5,440,000
	East Calumet Floodgate	7,820,000
	Charenton Floodgate	10,430,000
	Wax Lake East Drainage Structure	1,506,000
	Wax Lake West Drainage Structure	1,276,000
	Outlet Control (100/0)	13,380,000
	Widen Wax Lake Outlet	27,124,800
	Avoca Island Levee Extension	178,876,000
	Subtotal	500,980,800
	Contingencies (25% ±)	124,959,200
	Subtotal	625,940,000
	E&D (8%)	50,100,000
	S&A (8%)	50,100,000
	Total 11	726,140,000

TABLE C-3-21 (Continued)

COST ESTIMATE
NED Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	678,000
	Wax Lake West	472,000
	Ellerslie	77,000
	North Bend	179,000
	Maryland	179,000
	Centerville	179,000
	Bayou Yokely and Enlargement	805,000
	Franklin	155,000
	Gordy	218,000
	Subtotal	2,942,000
	Contingencies (25% ±)	738,000
	Subtotal	3,680,000
	E&D (8%)	290,000
	S&A (8%)	290,000
	Total 13	4,260,000
16	BANK STABILIZATION	
	Main Channel	72,335,000
	Channel Realinement	11,500,000
	Subtotal	83,835,000
	Contingencies (25% ±)	21,115,000
	Subtotal	104,950,000
	E&D (8%)	8,400,000
	S&A (8%)	8,400,000
	Total 16	121,750,000
	TOTAL	1,054,000,000

TABLE C-3-22

COST ESTIMATE
EQ Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Enlargement of Existing Levees and Floodwalls	6,875,000
	Channel Training Above Morgan City	327,000
	Channel Realinement	326,000
	Sherburne and Henderson Freshwater Structures	765,000
	Outlet Control (70/30)	14,000
	Increase Sediment Through WLO	16,000
	Widen Wax Lake Outlet	6,341,000
	Subtotal	14,664,000
	Contingencies (25% ±)	3,667,000
	Acquisition Cost	1,480,000
	Resettlement	533,000
	Total 01	20,344,000
02	RELOCATIONS	
	Enlargement of Existing Levees and Floodwalls	11,615,000
	Management Units	37,000
	Outlet Control (70/30)	365,000
	Widen Wax Lake Outlet	30,409,000
	Subtotal	42,426,000
	Contingencies (25% ±)	10,606,000
	Subtotal	53,032,000
	E&D (6%)	3,181,000
	S&A (6%)	3,181,000
	Total 02	59,394,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,420,000
	Subtotal	19,177,000
	Contingencies (25% ±)	4,783,000
	Subtotal	23,960,000
	E&D (8%)	1,920,000
	S&A (8%)	1,920,000
	Total 05	27,800,000

TABLE C-3-22 (Continued)

COST ESTIMATE
EQ Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
06	FISH AND WILDLIFE FACILITIES	
	Sherburne and Courtableau Freshwater Structures	4,830,000
	Contingencies (25% ±)	1,210,000
	Subtotal	6,040,000
	E&D (8%)	480,000
	S&A (8%)	480,000
	Total 06	7,000,000
09	CHANNELS AND CANALS	
	Channel Training Above Morgan City	35,750,000
	Channel Realinement	17,171,500
	Management Units	15,262,400
	Increase Sediment Through WLO	14,675,000
	Subtotal	82,858,900
	Contingencies (25%±)	21,057,100
	Subtotal	103,916,000
	E&D (8%)	8,180,000
	S&A (8%)	8,180,000
	Total 09	120,276,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	259,262,000
	Service Roads (429 miles)	5,440,000
	East Calumet Floodgate	7,820,000
	Charenton Floodgate	10,430,000
	Wax Lake East Drainage Structure	1,506,000
	Wax Lake West Drainage Structure	1,276,000
	Managment Units	1,070,400
	Outlet Control (70/30)	7,099,600
	Widen Wax Lake Outlet	27,124,800
	Subtotal	321,028,800
	Contingencies (25% ±)	80,669,200
	Subtotal	401,698,000
	E&D (8%)	32,239,000
	S&A (8%)	32,239,000
	Total 11	466,176,000

TABLE C-3-22 (Continued)

COST ESTIMATE
EQ Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	678,000
	Wax Lake West	472,000
	Ellerslie	77,000
	North Bend	179,000
	Maryland	179,000
	Centerville	179,000
	Bayou Yokely and Enlargement	805,000
	Franklin	155,000
	Gordy	218,000
	Subtotal	2,942,000
	Contingencies (25%±)	738,000
	Subtotal	3,680,000
	E&D (8%)	290,000
	S&A (8%)	290,000
	Total 13	4,260,000
16	BANK STABILIZATION	
	Main Channel	72,335,000
	Channel Realinement	11,500,000
	Subtotal	83,835,000
	Contingencies (25% ±)	21,115,000
	Subtotal	104,950,000
	E&D (8%)	8,400,000
	S&A (8%)	8,400,000
	Total 16	121,750,000
	TOTAL	827,000,000

TABLE C-3-23

COST ESTIMATE
Recommended Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Enlargement of Existing Levees and Floodwalls	6,901,000
	Channel Training Above Morgan City	327,000
	Channel Realinement	326,000
	Sherburne and Henderson Freshwater Structures	765,100
	Outlet Control (70/30)	14,000
	Widen Wax Lake Outlet	6,341,000
	Channel Training Below Morgan City	617,000
	Subtotal	15,291,100
	Contingencies (25%±)	3,823,900
	Acquisition Cost	1,528,000
	Resettlement	687,000
	Total 01	21,330,000
02	RELOCATIONS	
	Enlargement of Existing Levees and Floodwalls	14,970,000
	Management Units	37,000
	Outlet Control (70/30)	365,000
	Widen Wax Lake Outlet	30,409,000
	Subtotal	45,781,000
	Contingencies (25%±)	11,233,000
	Subtotal	57,014,000
	E&D (6%)	3,512,000
	S&A (6%)	3,512,000
	Total 02	64,038,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,420,000
	Subtotal	19,177,000
	Contingencies (25%±)	4,783,000
	Subtotal	23,960,000
	E&D (8%)	1,920,000
	S&A (8%)	1,920,000
	Total 05	27,800,000

TABLE C-3-23 (Continued)

COST ESTIMATE
Recommended Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
06	FISH AND WILDLIFE FACILITIES	
	Sherburne and Henderson Freshwater Structures	4,830,000
	Contingencies (25%±)	1,190,000
	Subtotal	6,020,000
	E&D (8%)	500,000
	S&A (8%)	500,000
	Total 06	7,020,000
09	CHANNELS AND CANALS	
	Channel Training Above Morgan City	35,750,000
	Channel Realinement	9,715,000
	Management Units	15,262,400
	Channel Training Below Morgan City	7,454,000
	Subtotal	68,181,400
	Contingencies (25%±)	17,252,600
	Subtotal	85,434,000
	E&D (8%)	6,684,000
	S&A (8%)	6,684,000
	Total 09	98,802,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	238,000,000
	Service Roads (429 miles)	5,440,000
	East Calumet Floodgate	7,820,000
	Charenton Floodgate	10,430,000
	Wax Lake East Drainage Structure	1,566,000
	Wax Lake West Drainage Structure	1,276,000
	Management Units	1,070,400
	Outlet Control (70/30)	7,099,600
	Widen Wax Lake Outlet	27,124,800
	Subtotal	299,766,800
	Contingencies (25%±)	75,233,200
	Subtotal	375,000,000
	E&D (8%)	30,000,000
	S&A (8%)	30,000,000
	Total 11	435,000,000

TABLE C-3-23 (Continued)

COST ESTIMATE
Recommended Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	678,000
	Wax Lake West	472,000
	Ellerslie	77,000
	North Bend	179,000
	Maryland	179,000
	Centerville	179,000
	Bayou Yokely and Enlargement	805,000
	Franklin	155,000
	Gordy	218,000
	Subtotal	2,942,000
	Contingencies (25% ±)	738,000
	Subtotal	3,680,000
	E&D (8%)	290,000
	S&A (8%)	290,000
	Total 13	4,260,000
16	BANK STABILIZATION	
	Main Channel	72,335,000
	Channel Realinement	11,500,000
	Subtotal	83,835,000
	Contingencies (25% ±)	21,115,000
	Subtotal	104,950,000
	E&D (8%)	8,400,000
	S&A (8%)	8,400,000
	Total 16	121,750,000
	TOTAL	780,000,000

TABLE C-3-24

COST ESTIMATE
CONSTRUCTION STARTS SCHEDULED FOR FY 1982-1985*

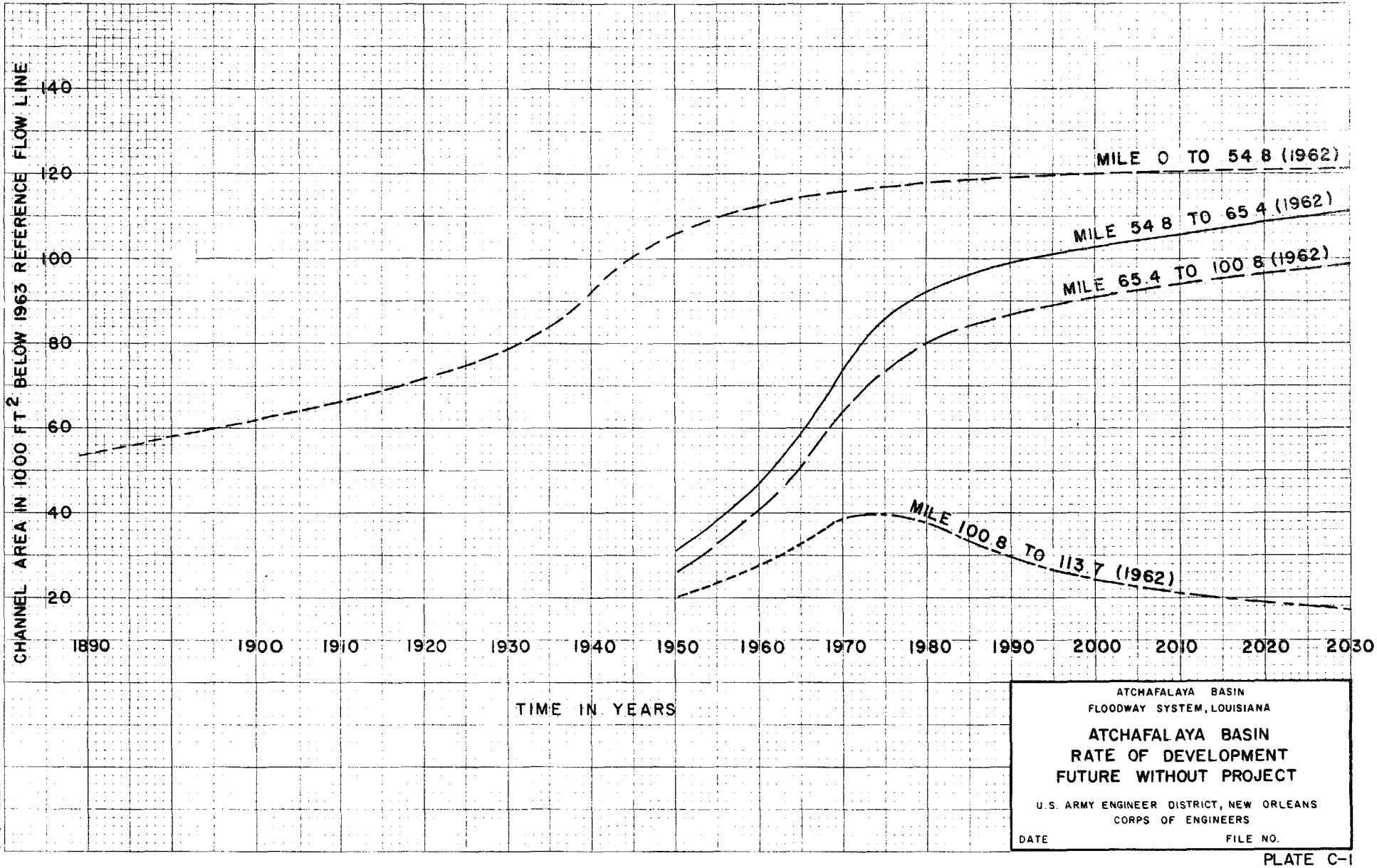
01	LANDS AND DAMAGES	993,000
02	RELOCATIONS	8,898,000
11	LEVEES AND FLOODWALLS	167,185,000
30	E&D	13,890,000
31	S&A	13,890,000
	TOTAL	204,856,000

*Based on schedule in 20 November 1979 PB-2A and October 1981 PB-3

TABLE C-3-25

PLAN FEATURE SUMMARY

	EQ	NED	TS	RCMD
Raised Levees Where Required	X	X	X	X
Main Channel				
Dredge 100,000 square feet				
Channel Training	X	X	X	X
Overbanks				
Channel Realinement	X	X	X	X
Management Units	X		X	X
Outlets (LAR/WLO)				
70/30	X		X	X
100/0		X		
Increase Sediment thru WLO	X			
Widen WLO overbank	X	X	X	X
Lower Atchafalaya River				
Avoca Island Levee Extension		X	X	
Channel Training below Morgan City		X	X	X



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
FUTURE WITHOUT PROJECT

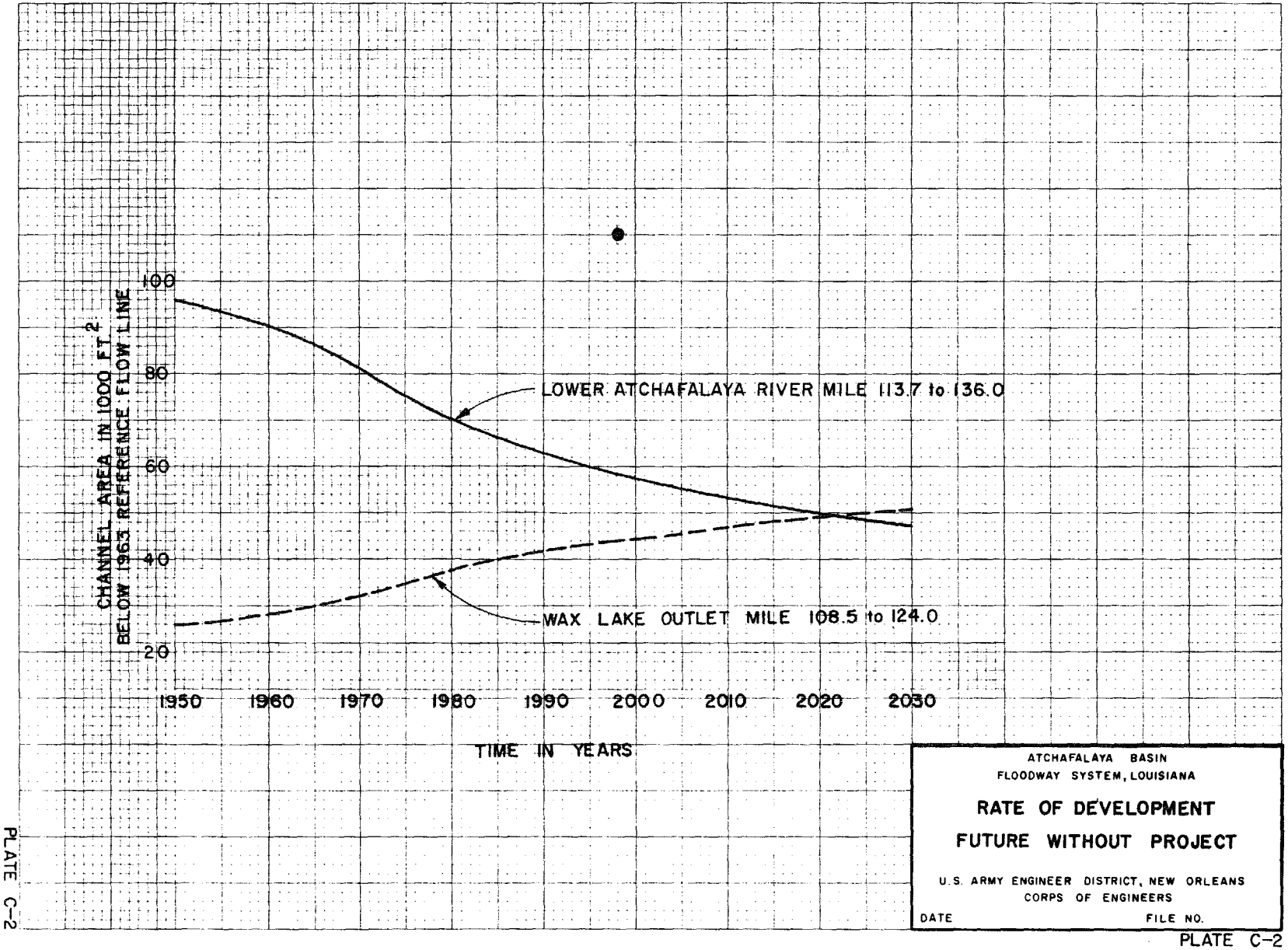
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-1

PLATE C-1

MADE IN U.S.A.
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

RATE OF DEVELOPMENT

FUTURE WITHOUT PROJECT

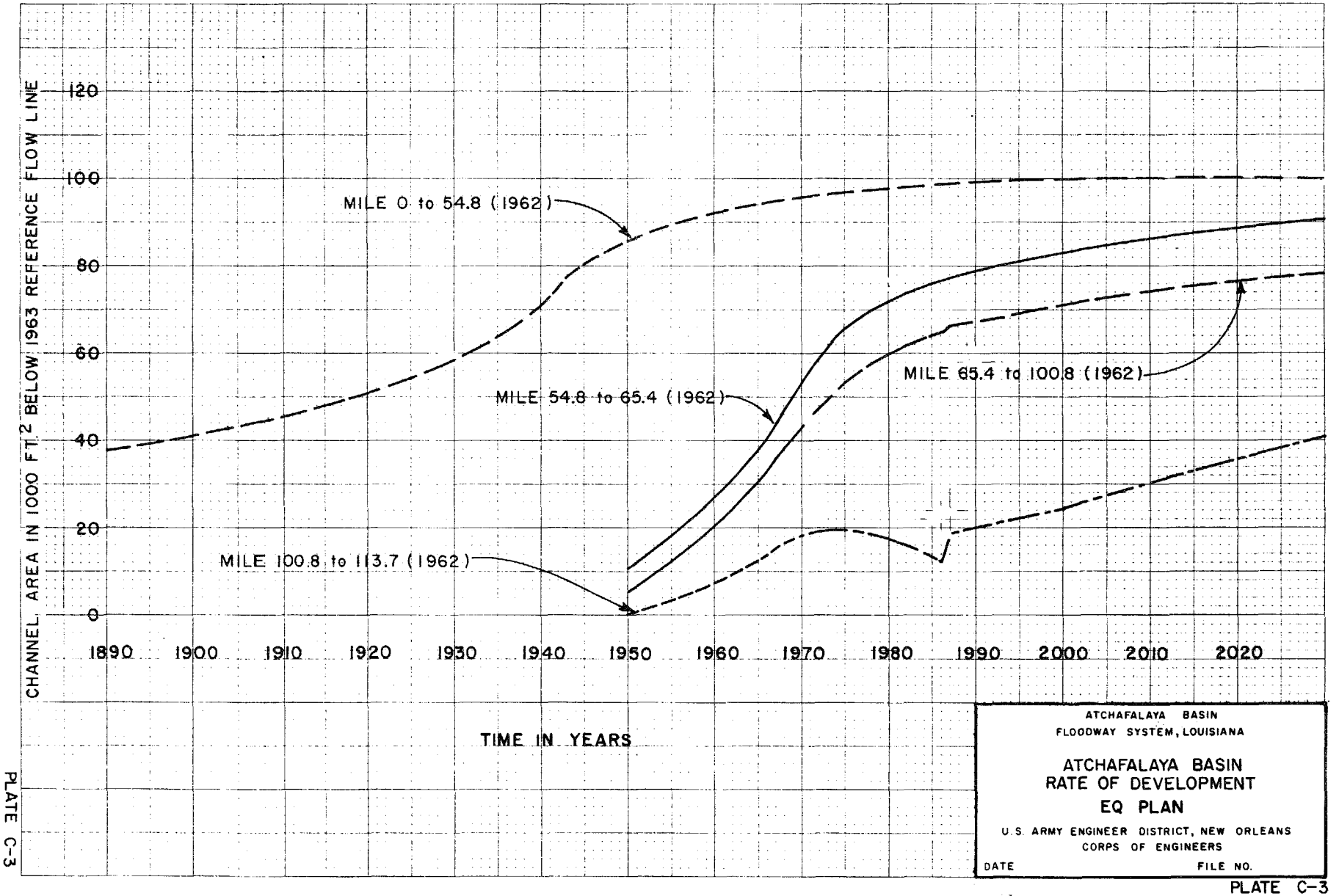
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-2

PLATE C-2

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340C-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
EQ PLAN

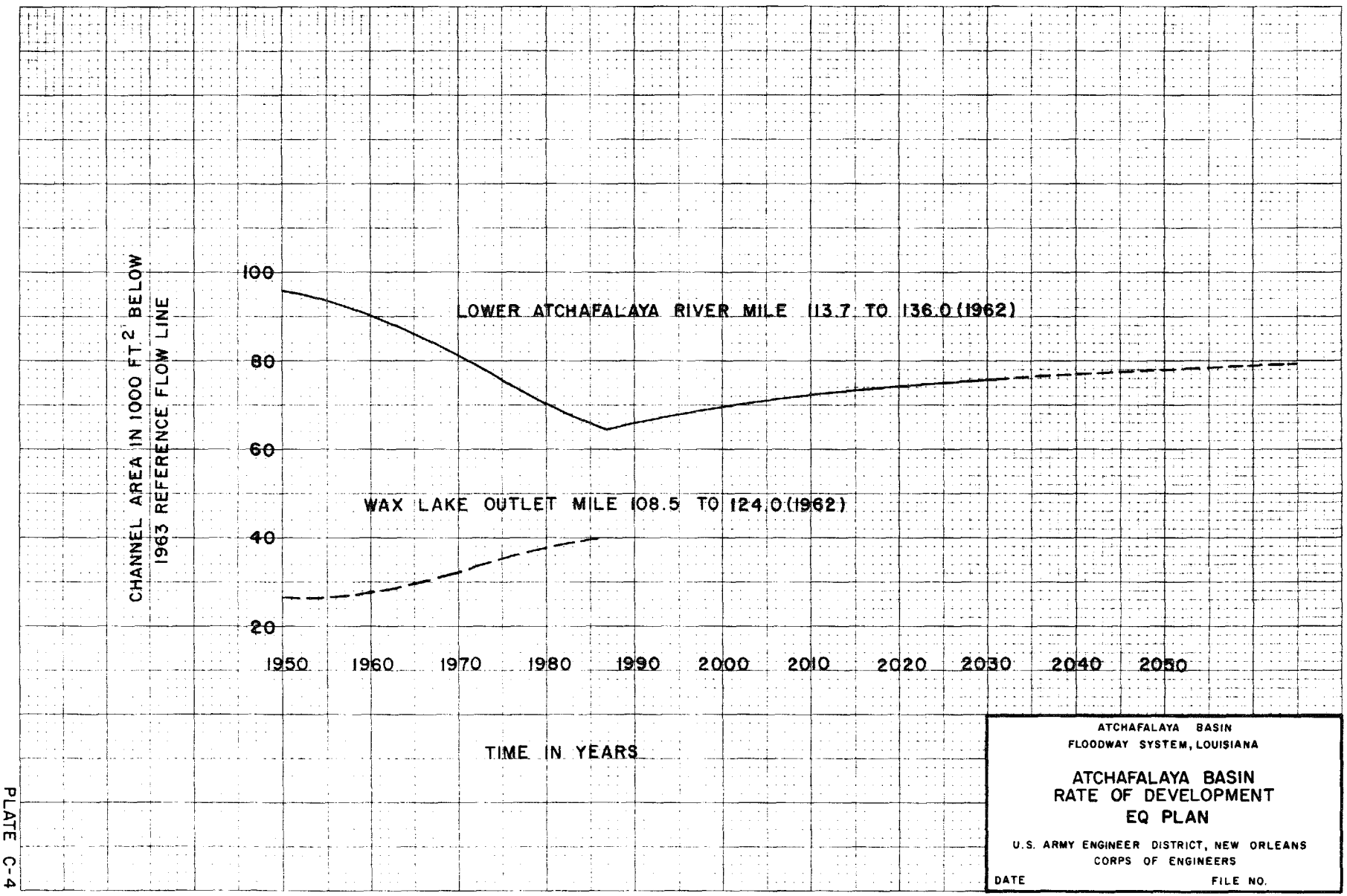
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-3

PLATE C-3

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 3400-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
EQ PLAN

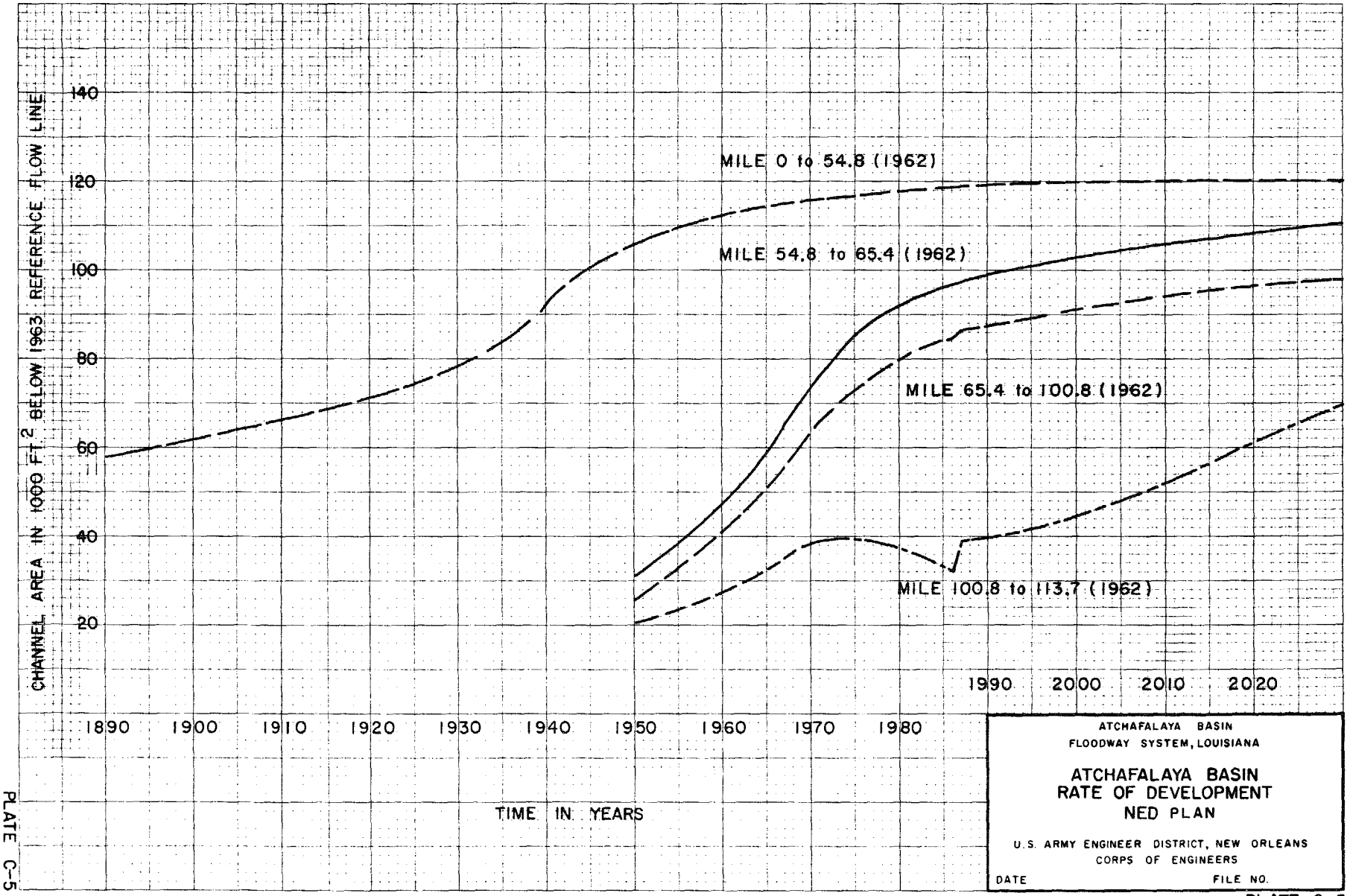
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-4

PLATE C-4

EUGENE DIETZGEN CO
MADE IN U. S. A.
NO. 3400 : D. DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
NED PLAN

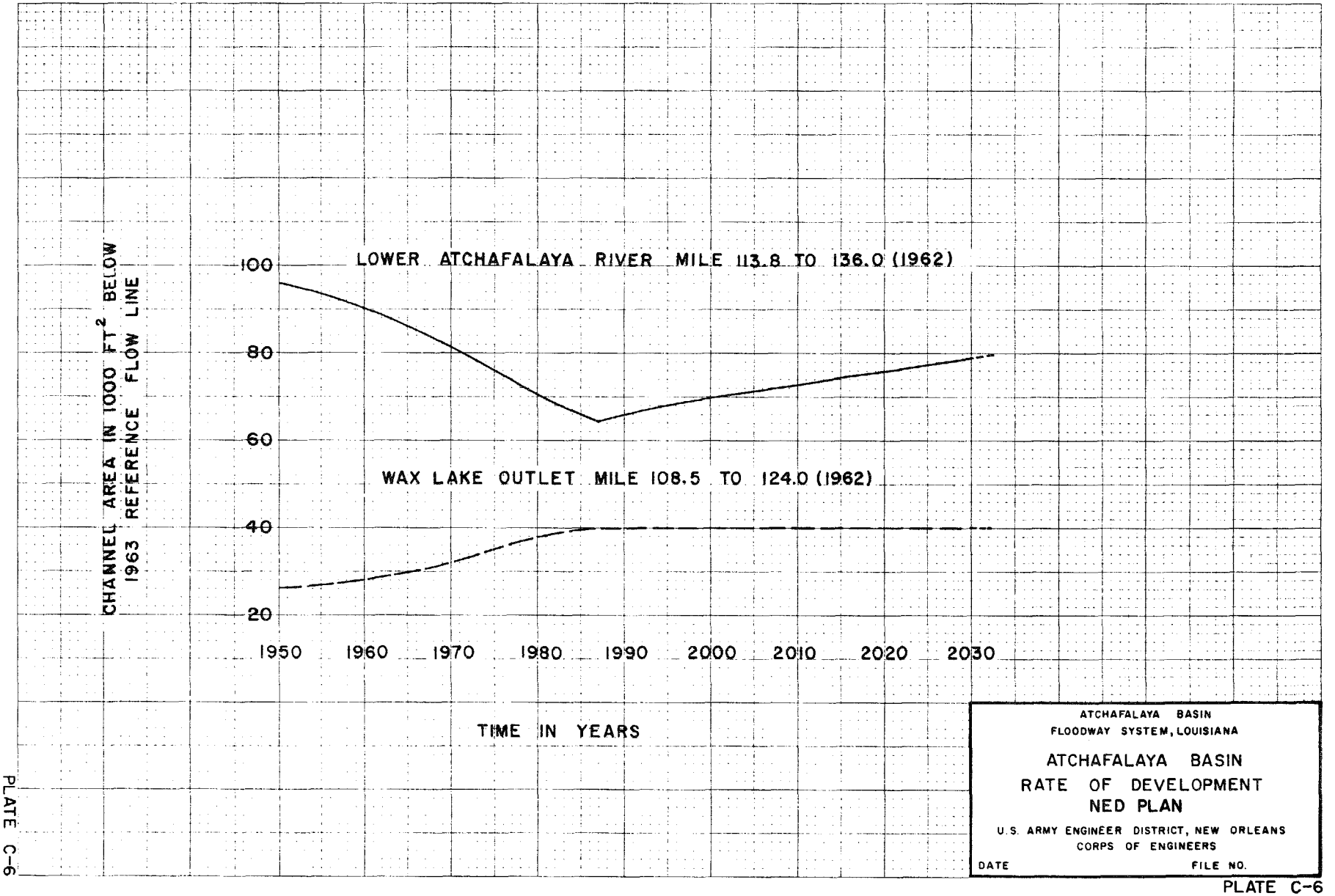
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-5

PLATE C-5

EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340D-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
NED PLAN

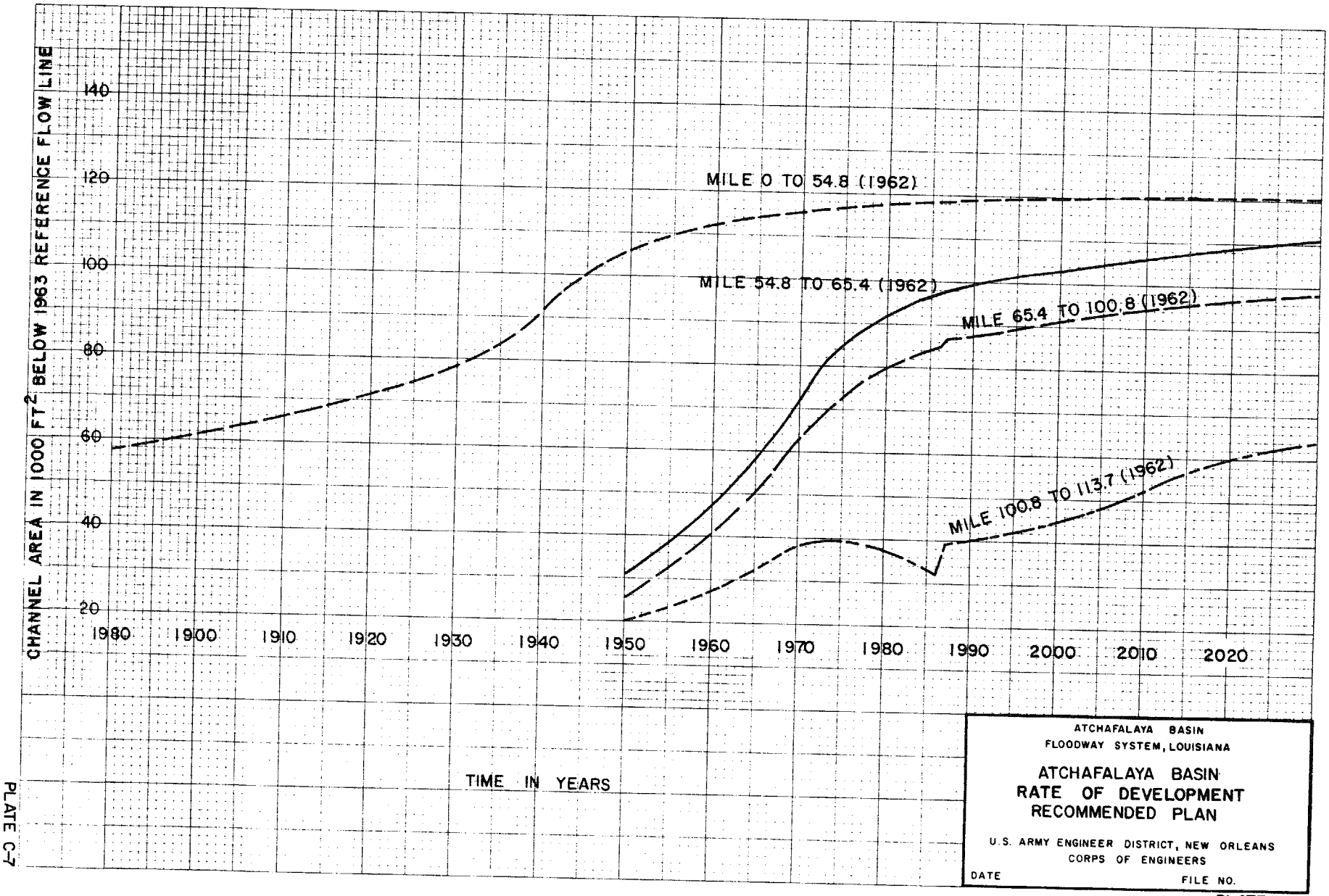
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-6

PLATE C-6

EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340D-10 DIETZGEN "AFH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
RECOMMENDED PLAN

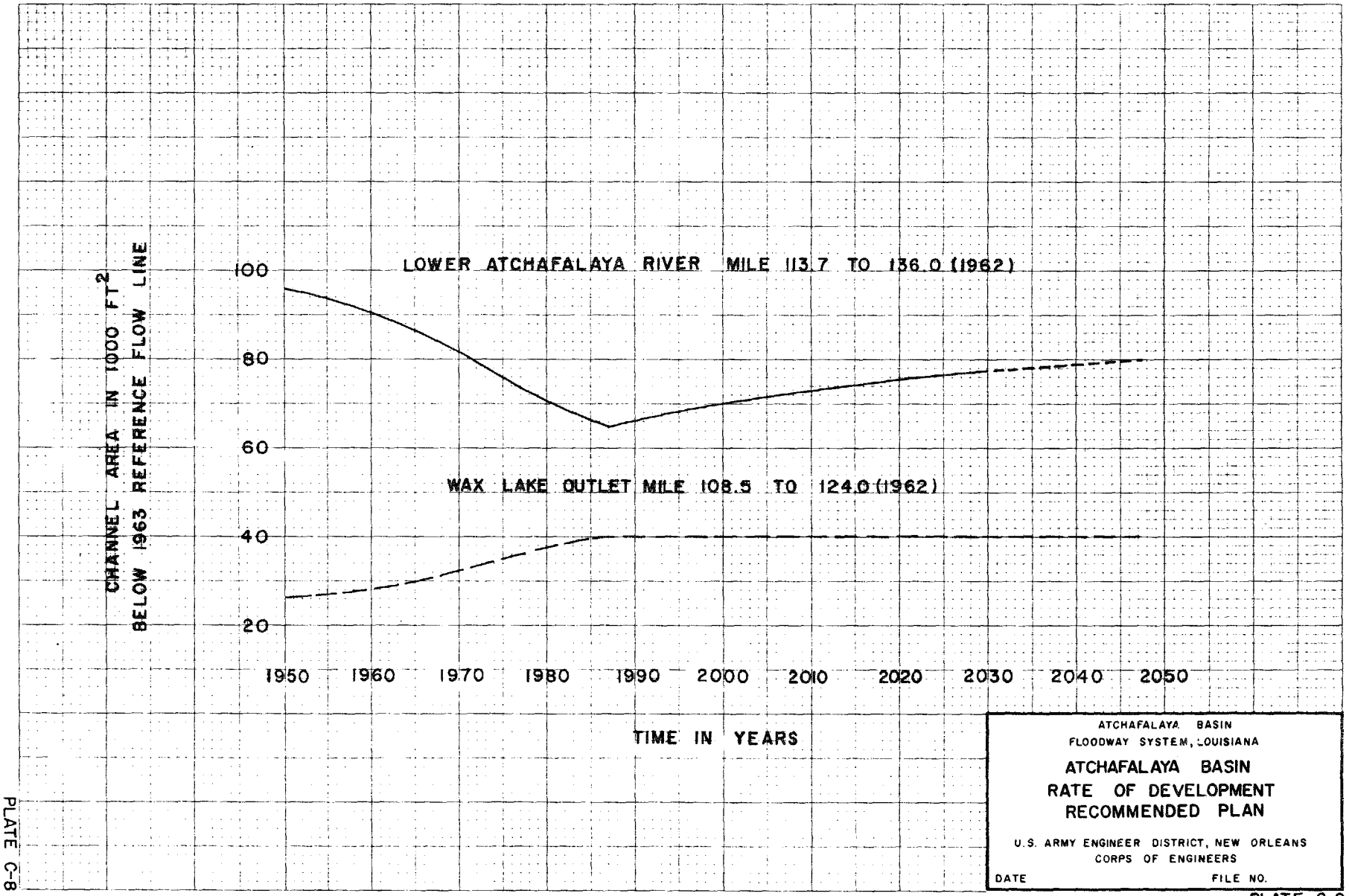
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-7

PLATE C-7

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340C-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
RECOMMENDED PLAN

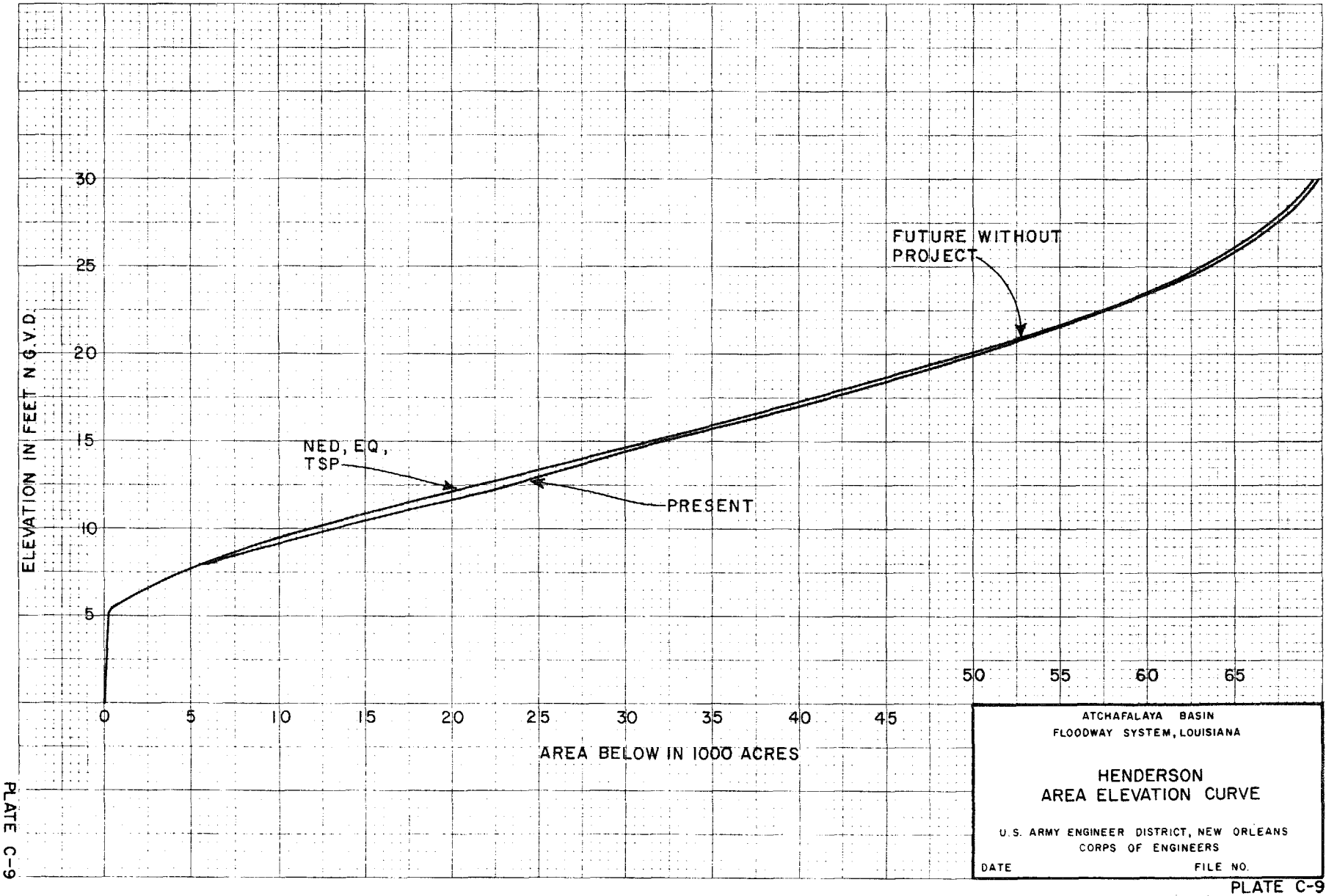
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-8

PLATE C-8

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340D 10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

HENDERSON
AREA ELEVATION CURVE

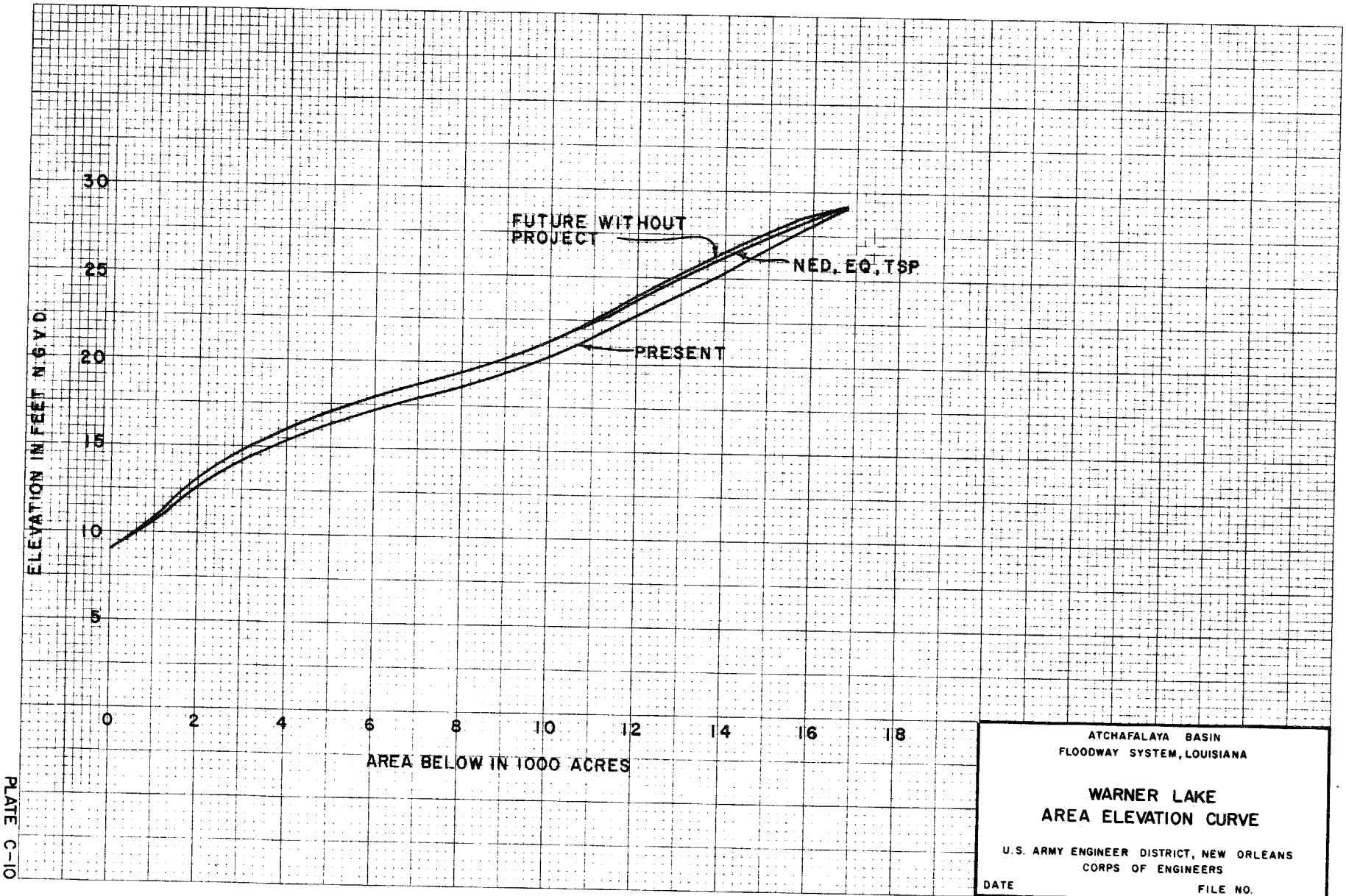
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-9

PLATE C-9

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340D 10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

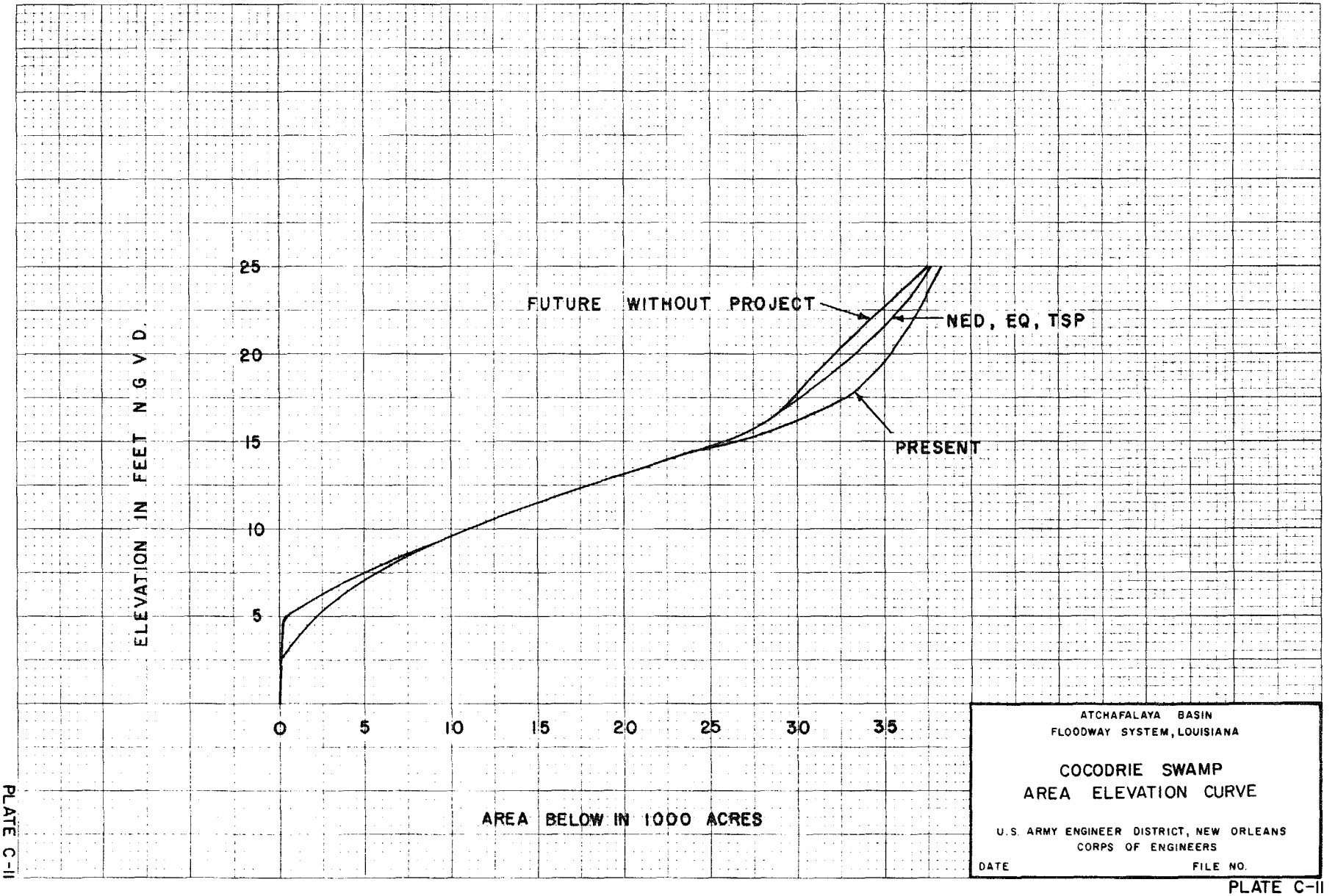
WARNER LAKE
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-10

PLATE C-10



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

COCODRIE SWAMP
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

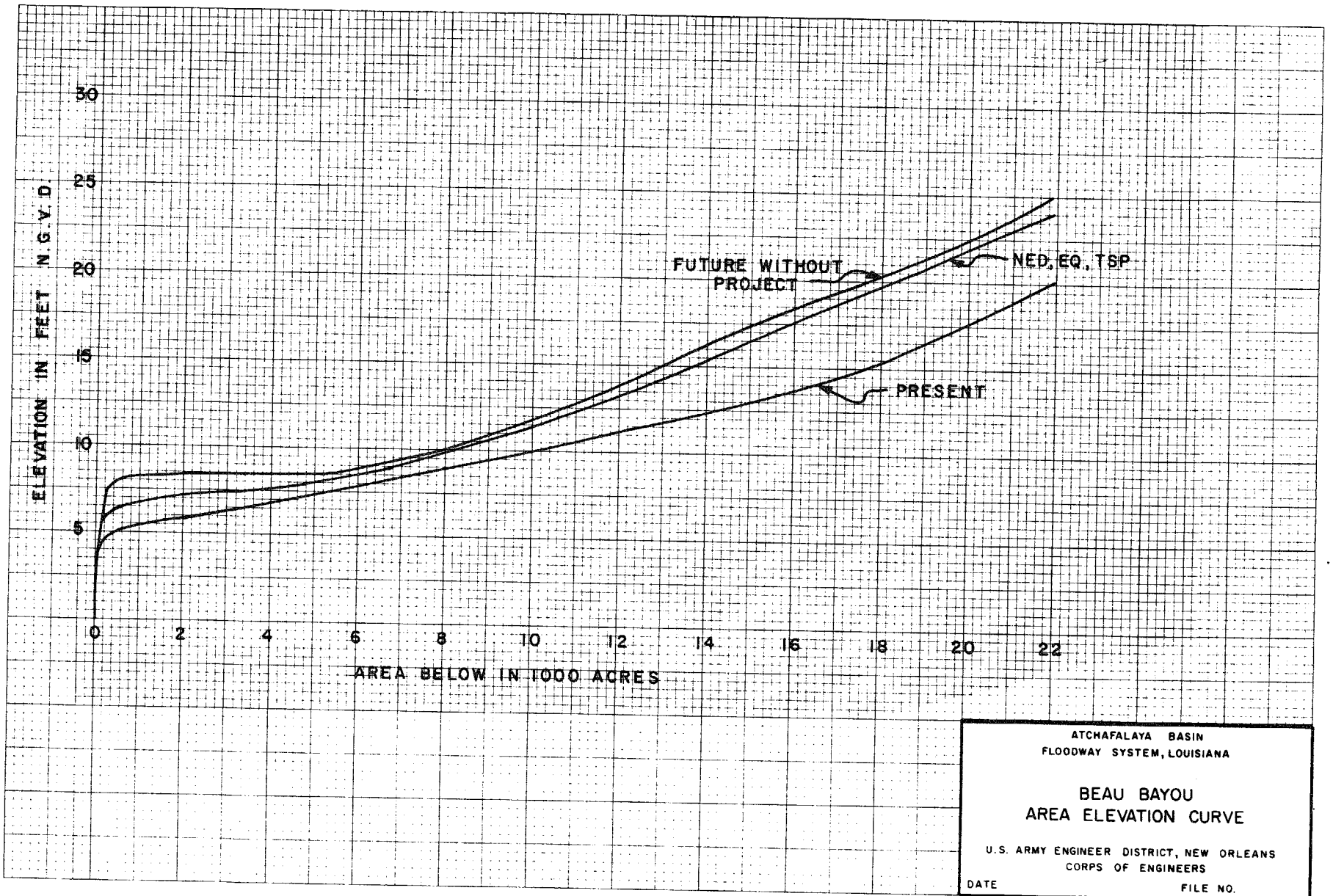
DATE FILE NO.

PLATE C-11

PLATE C-11

EUGENE DIETZGEN CO.
MADE IN U. S. A.

NO 3430-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BEAU BAYOU
AREA ELEVATION CURVE

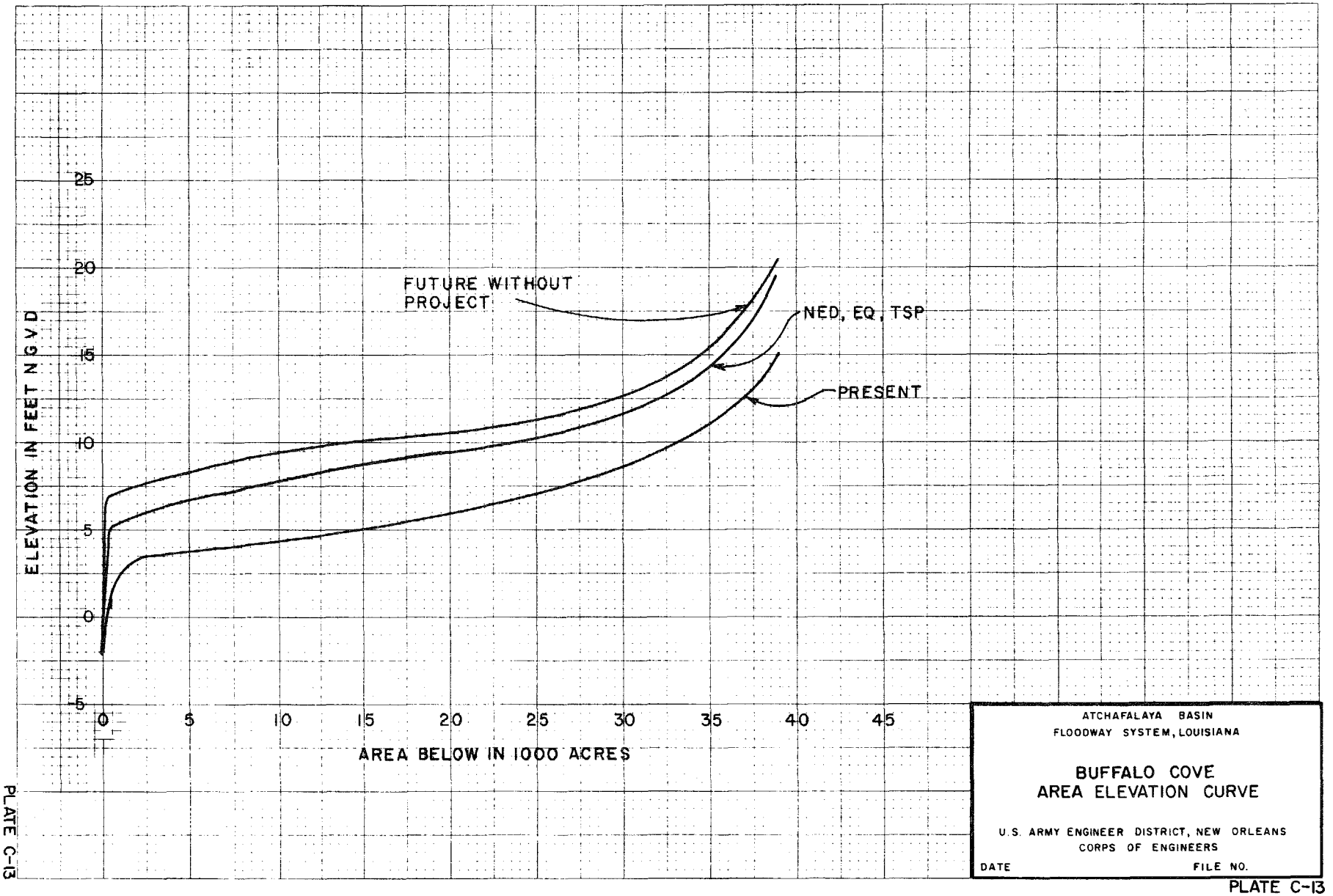
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-12

PLATE C-12

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO 3400-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BUFFALO COVE
AREA ELEVATION CURVE

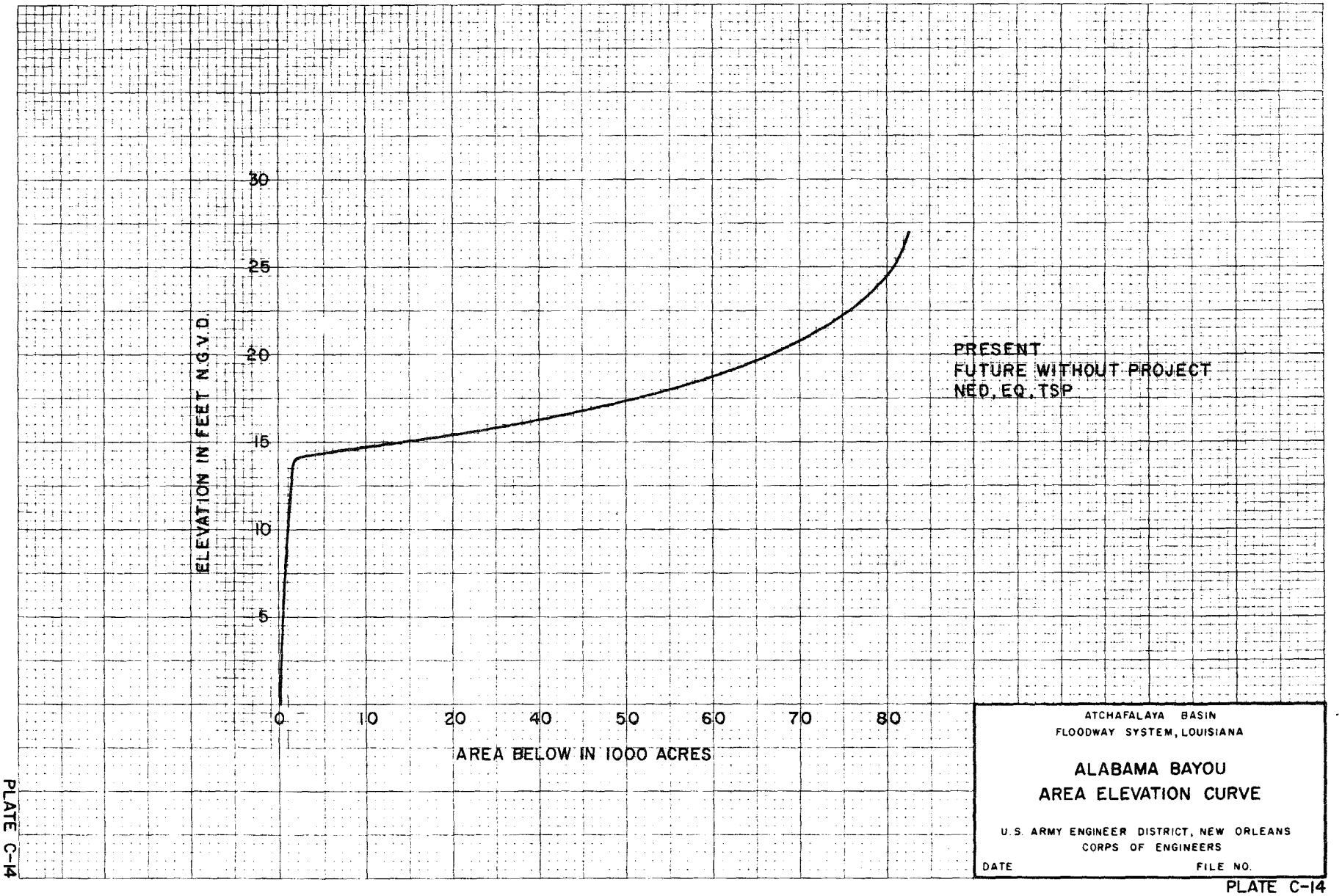
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-13

PLATE C-13

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340D-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ALABAMA BAYOU
AREA ELEVATION CURVE

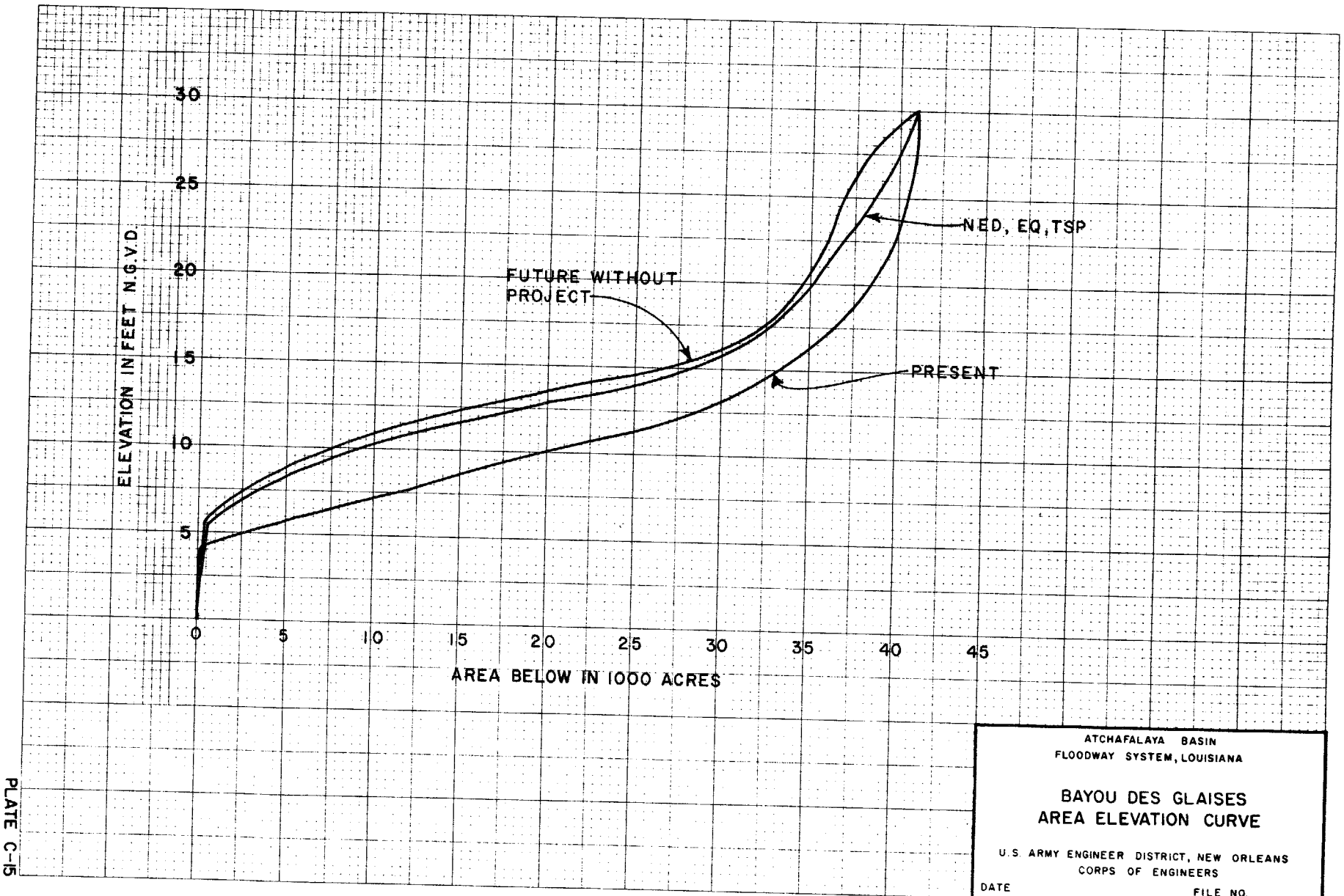
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-14

PLATE C-14

NO. 340D 10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
EUGENE DIETZGEN CO.
MADE IN U.S.A.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BAYOU DES GLAISES
AREA ELEVATION CURVE

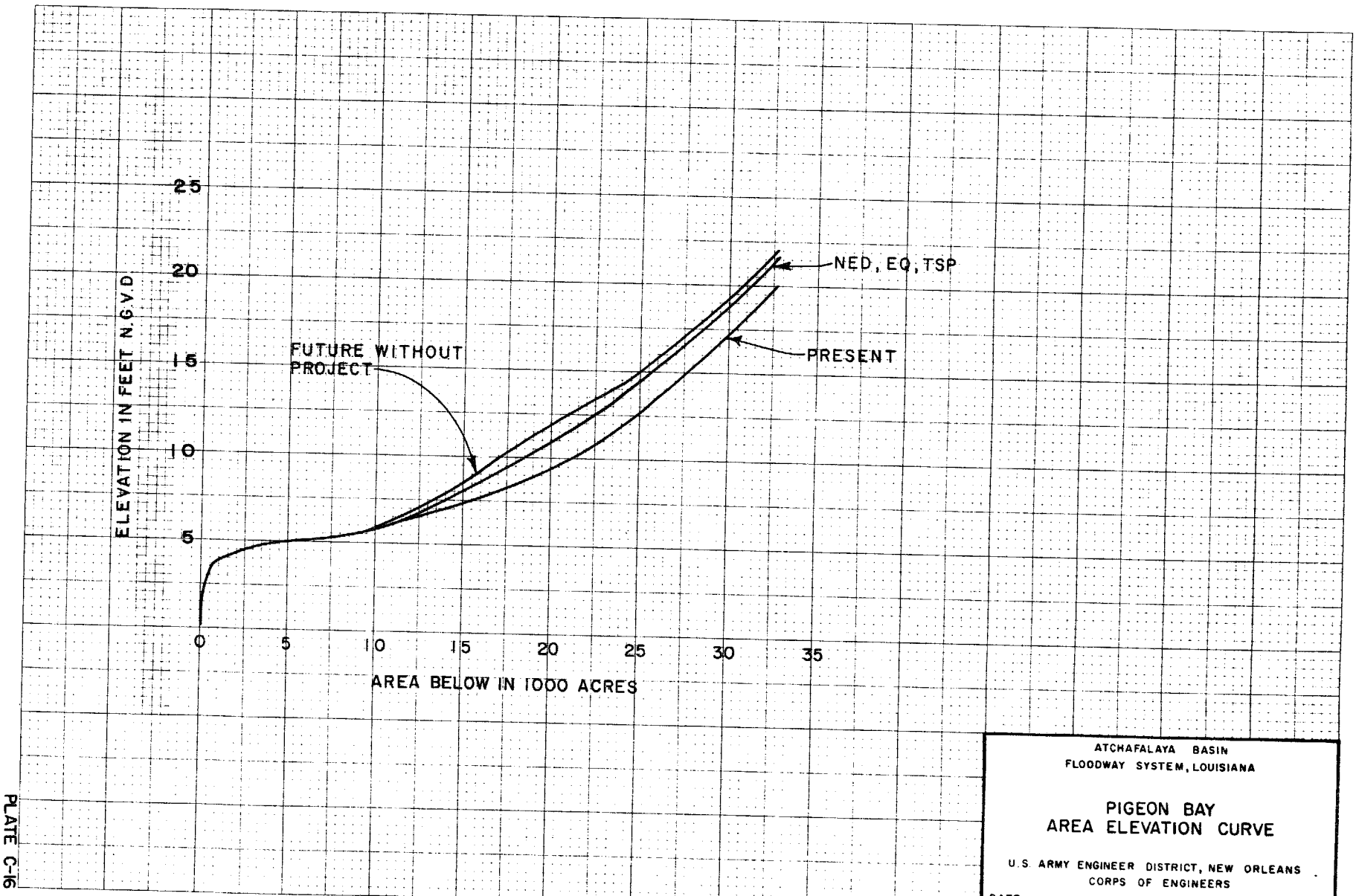
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-15

PLATE C-15

EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 340D-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

PIGEON BAY
AREA ELEVATION CURVE

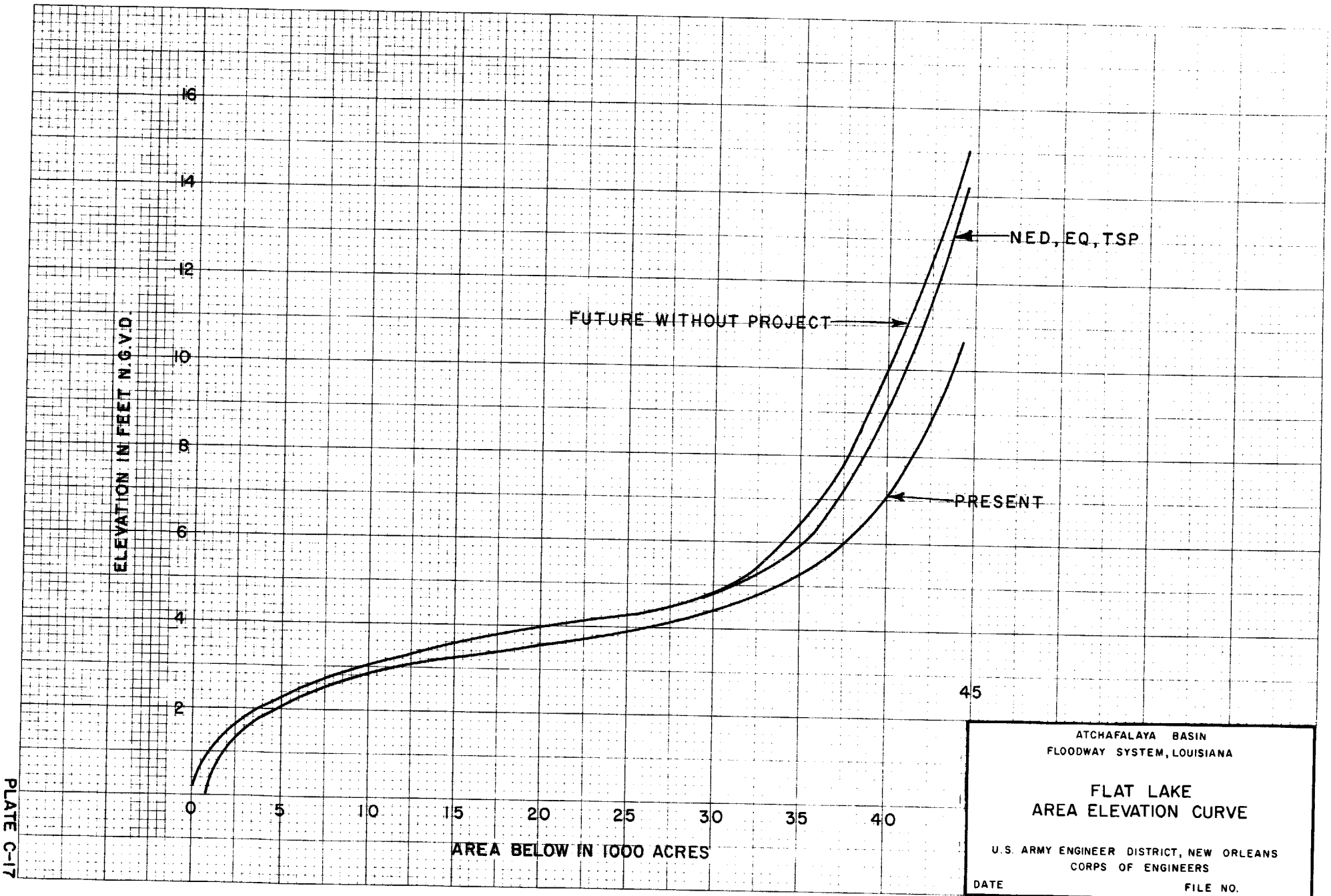
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-16

PLATE C-16

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 3400-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

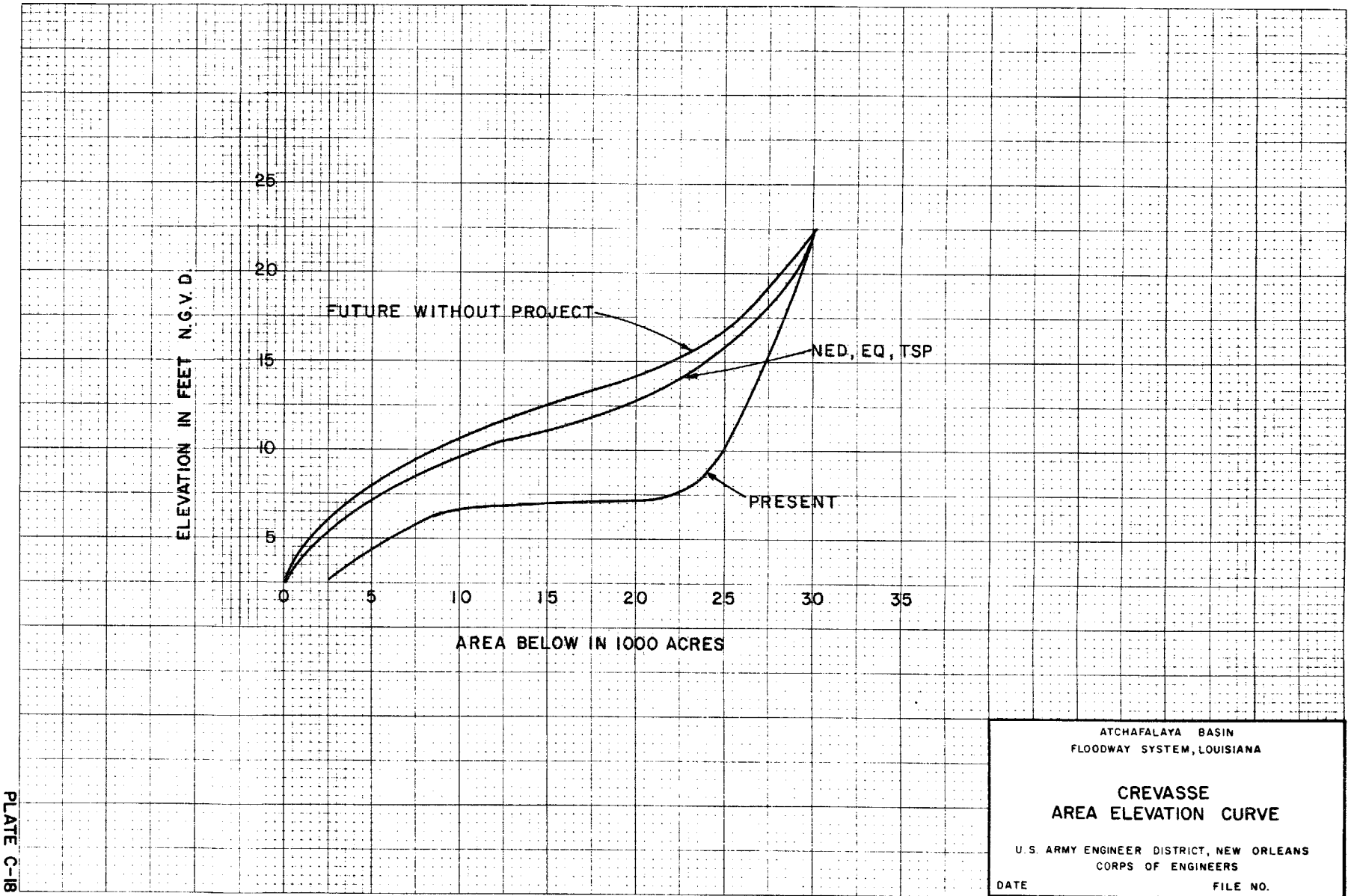
FLAT LAKE
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-17

PLATE C-17



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

CREVASSE
AREA ELEVATION CURVE

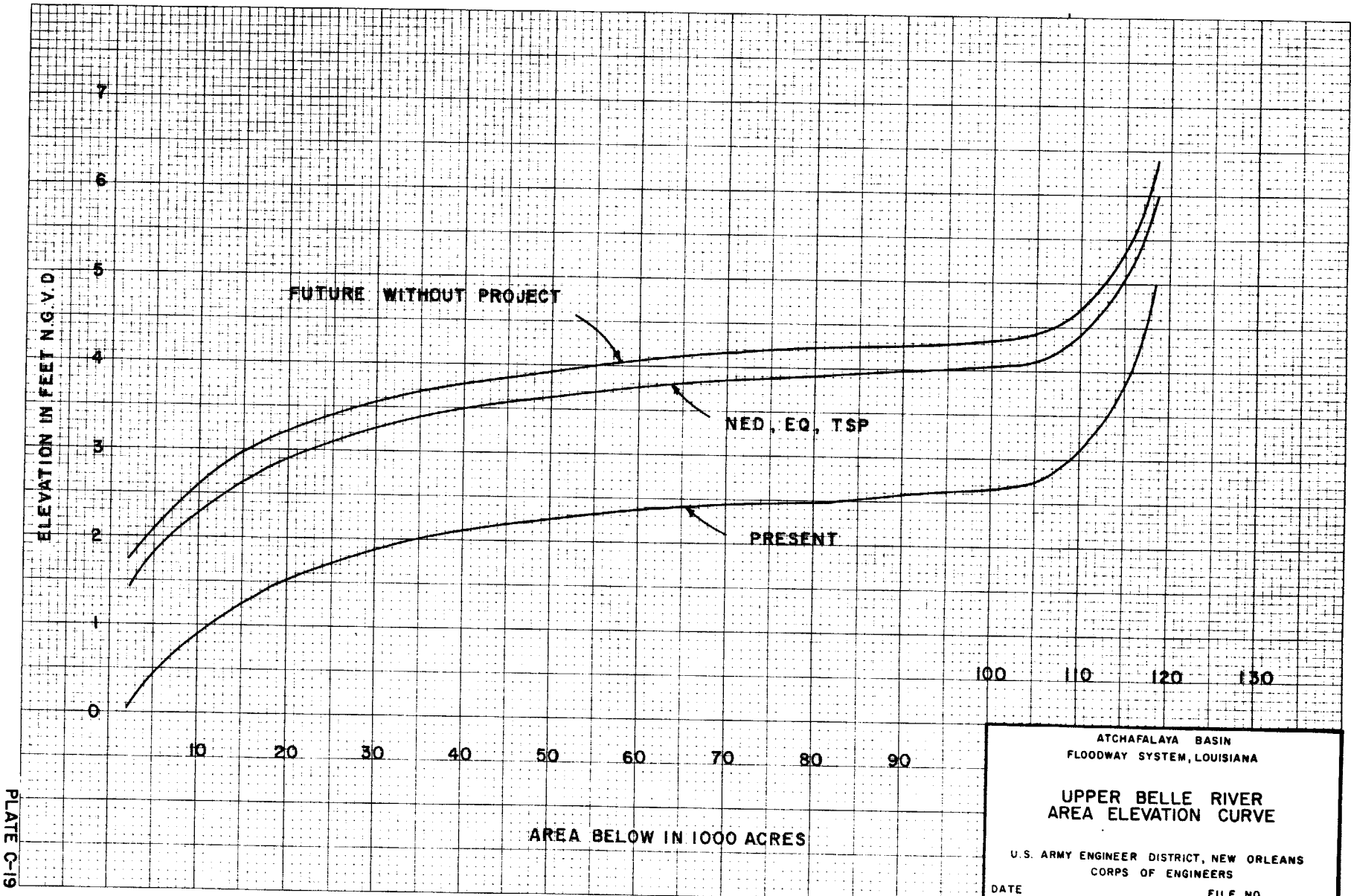
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-18

PLATE C-18

EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 3400-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

UPPER BELLE RIVER
AREA ELEVATION CURVE

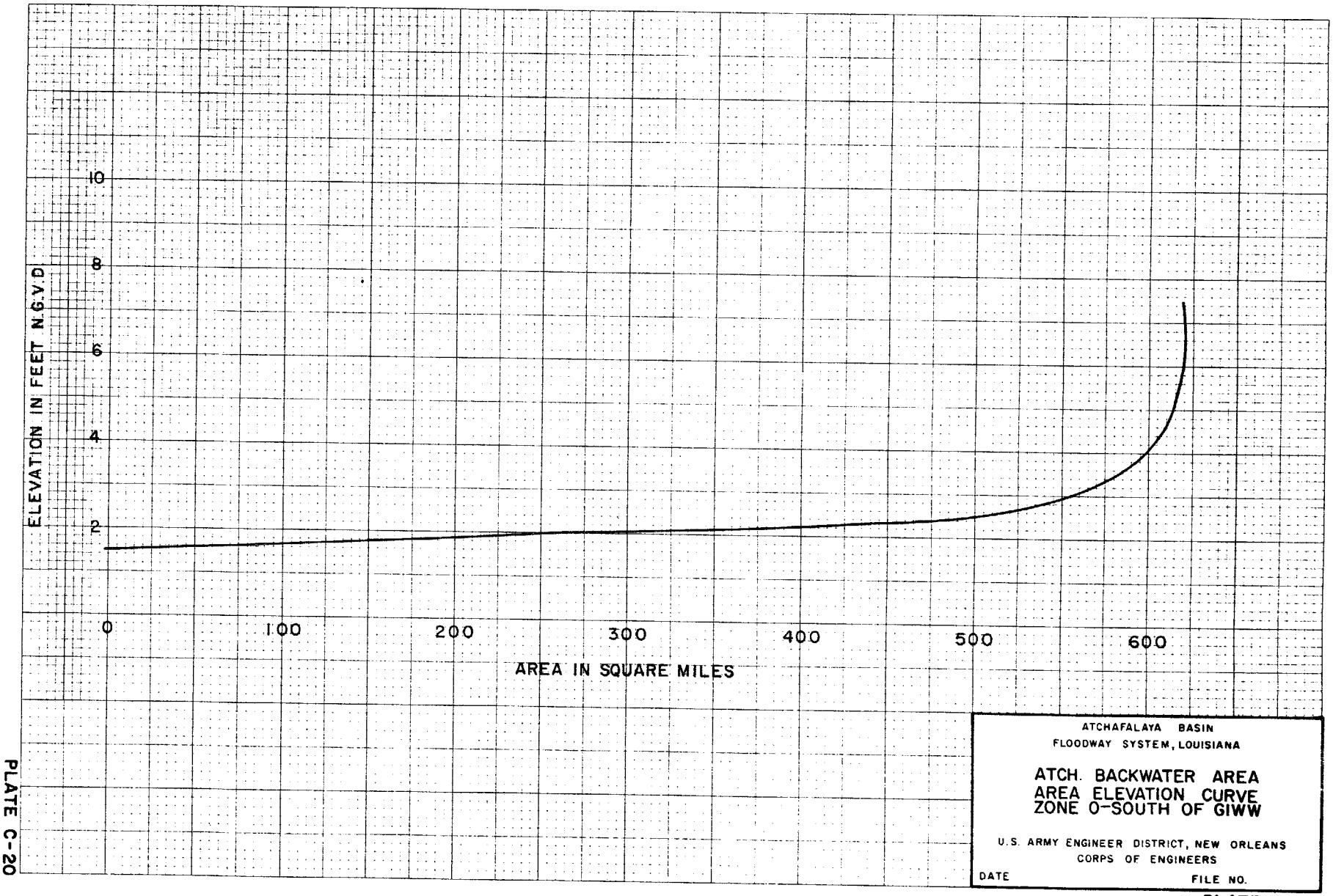
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-19

PLATE C-19

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340D-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCH. BACKWATER AREA
AREA ELEVATION CURVE
ZONE O-SOUTH OF GIWW

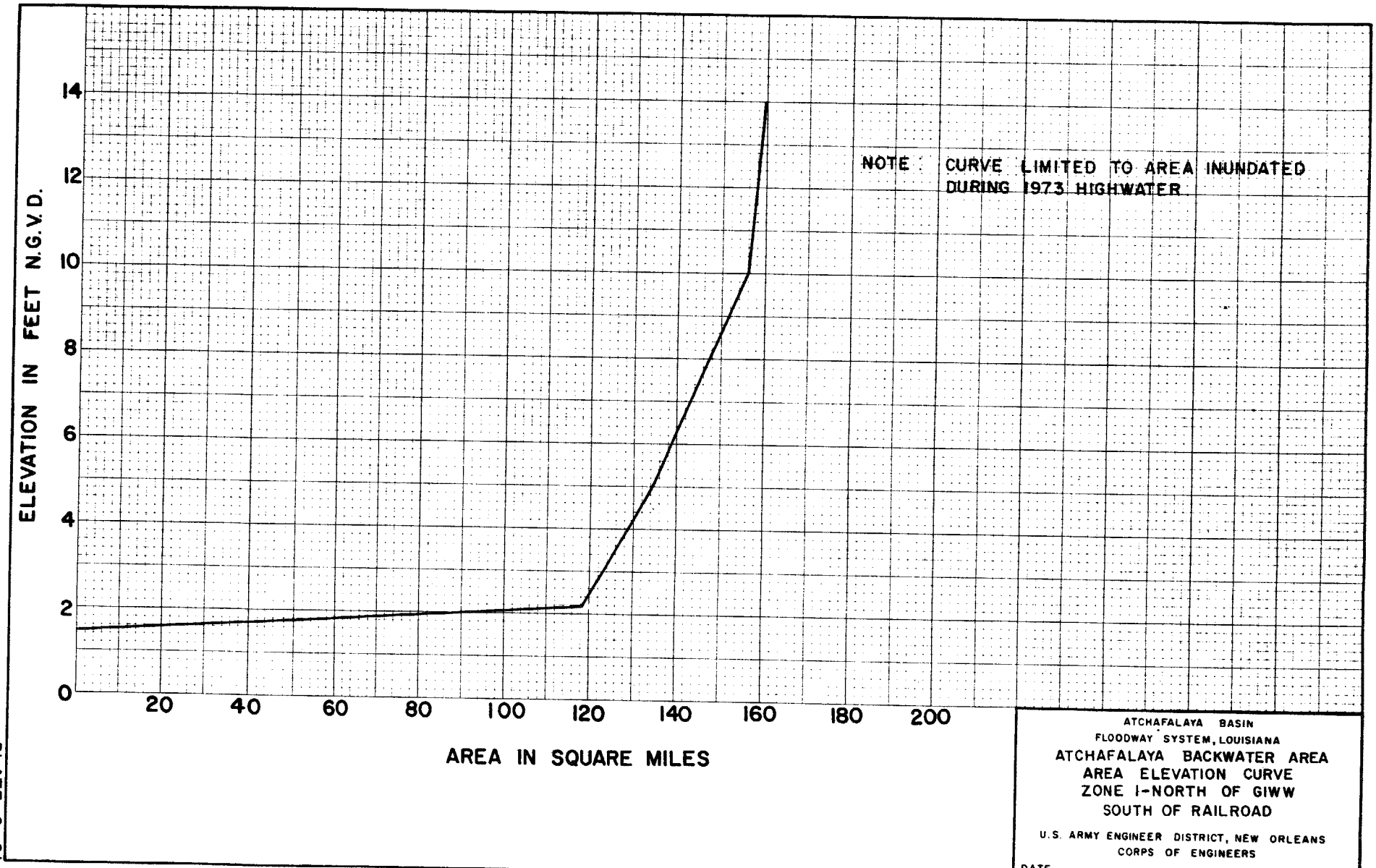
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-20

PLATE C-20

EUGENE DIETZGEN CO.
MADE IN U.S.A.
NO. 340D-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BACKWATER AREA
AREA ELEVATION CURVE
ZONE 1-NORTH OF GIWW
SOUTH OF RAILROAD

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-21

PLATE C-21

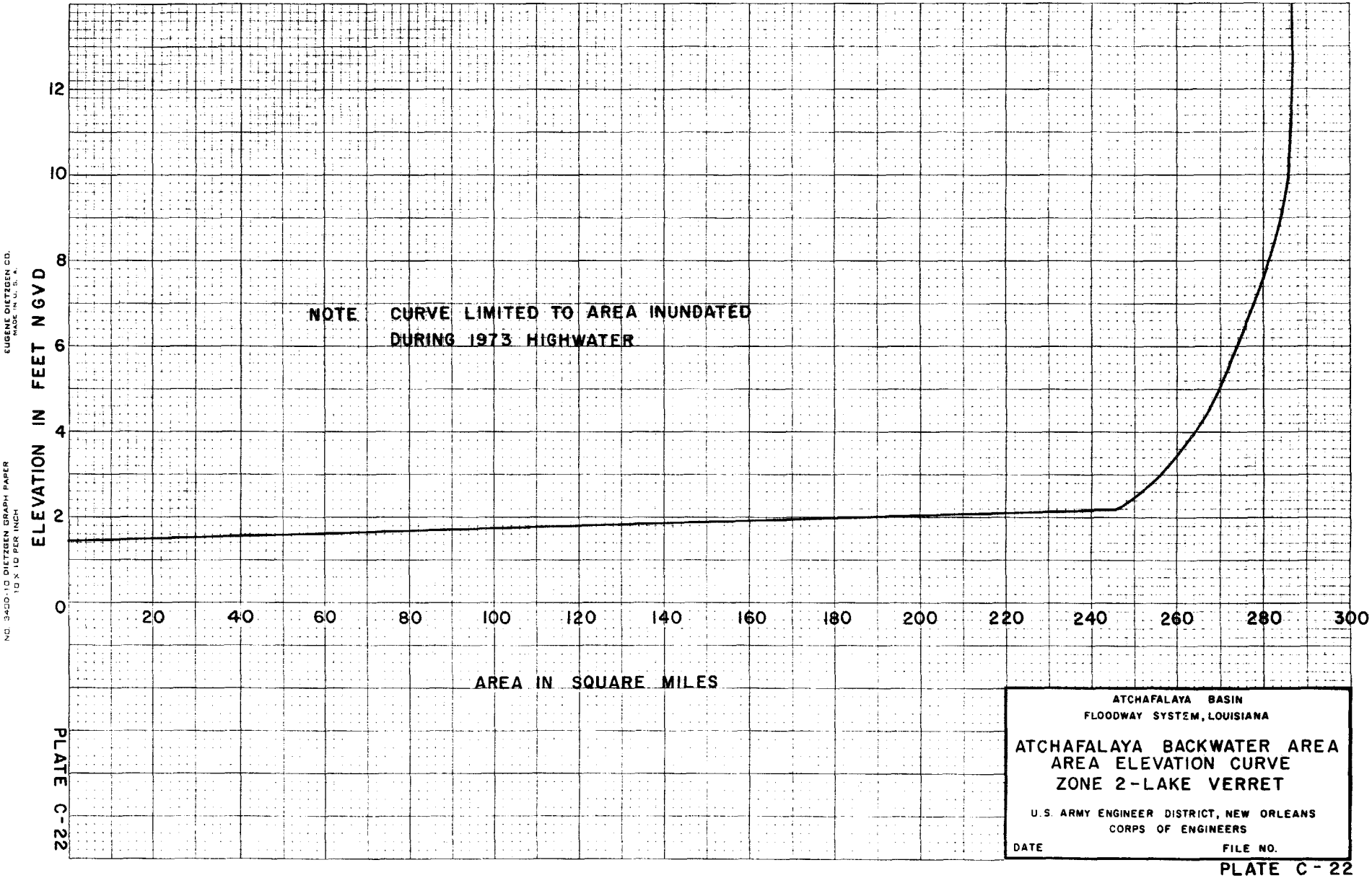
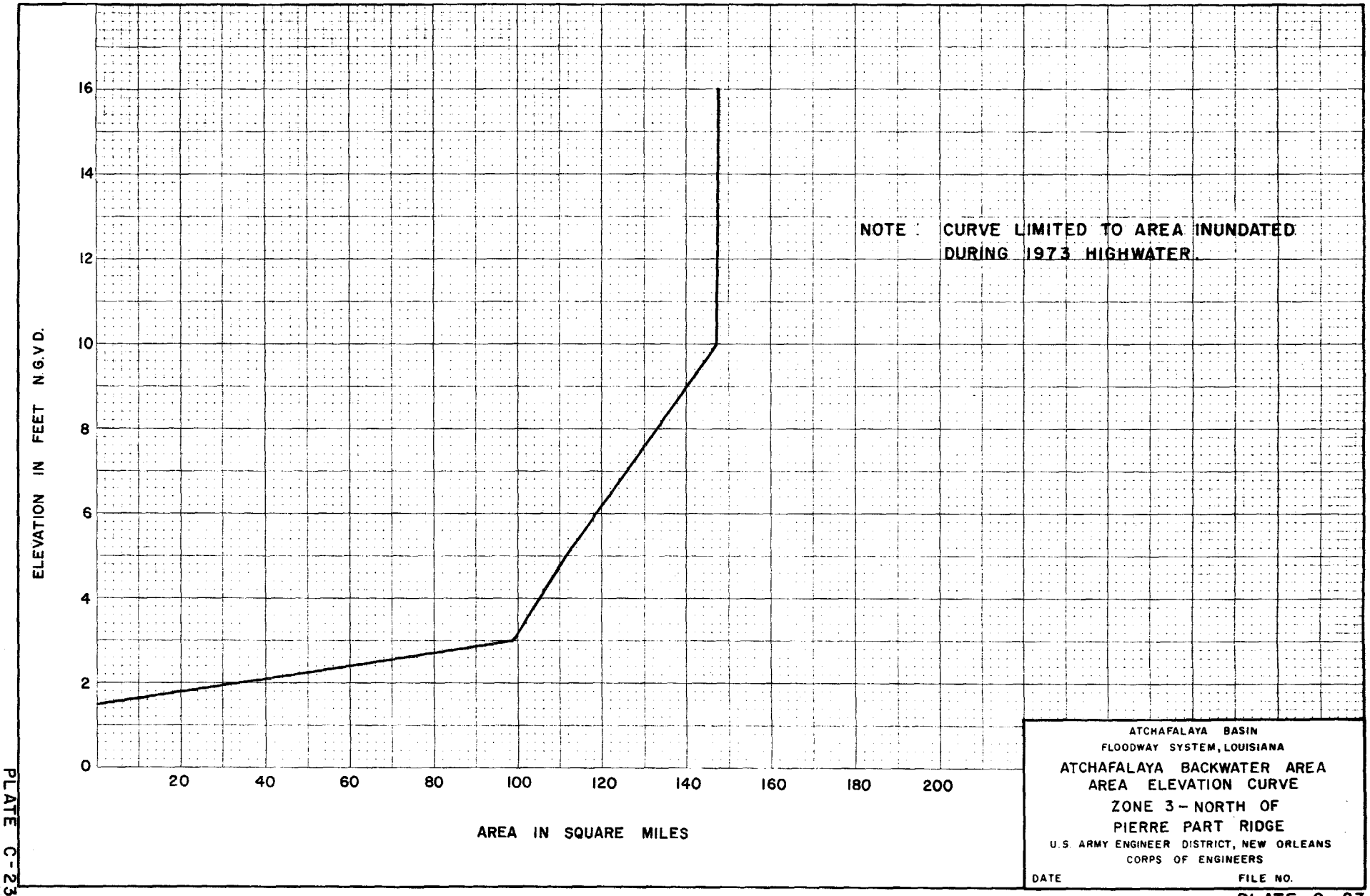

ELEVATION IN FEET N G V D
12
10
8
6
4
2
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
AREA IN SQUARE MILES
NOTE CURVE LIMITED TO AREA INUNDATED
DURING 1973 HIGHWATER
EUGENE DIETZGEN CO.
MADE IN U. S. A.
NO. 3400-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
PLATE C-22
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BACKWATER AREA
AREA ELEVATION CURVE
ZONE 2-LAKE VERRET
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-22



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BACKWATER AREA
AREA ELEVATION CURVE
ZONE 3 – NORTH OF
PIERRE PART RIDGE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE FILE NO.

PLATE C-23

PLATE C-23

WEST ATCHAFALAYA FLOODWAY
MORGANZA FLOODWAY
H.W.No.9
KROTZ SPRINGS
LOWER LIMIT OF WEST ATCHAFALAYA FLOODWAY
LOWER LIMIT OF MORGANZA FLOODWAY
H.W. No. 10
H.W.No.11
H.W.No.12
H.W.No.13
H.W.No.14
ATCHAFALAYA RIVER
WBPC No.1
15.8 (6-23)
WBPC Nr. Head
H.W.No.15
15.6 (6-23)
WBPC No.331
15.2 (6-23)
Atchafalaya Gage
AL-KA
79,900 (6-23)
AT-P
67,400 (6-23)
Closed
H.W.No.16
15.2 (6-23)
AT-I
6,480 (6-23)
WBPC No.160
(Henderson)
Lenora
U-Bo
54,900 (6-23)
Butte La Rose
U-G
540 (6-23)
WBPC Ext."O"
13.3 (6-24)
H.W.No.17
CH-A
8,850 (6-23)
AT-L
1,170 (6-22)
Cow Is Cut
13.9 (6-23)
CH-D
57,500 (6-23)
H.W.No.18
Blind Tensas Cut
Closure
Dike
Bayou La Rompe
U-L
75,300 (6-24)
CH-G
24,400 (6-23)
CH-Ob
3,650 (6-24)
CH-N
980 (6-24)
CH-P
38,500 (6-24)
CH-Q
78,300 (6-24)
Lake Mongoulois
CH-S
7,540 (6-24)
CH-Ta
15,100 (6-24)
CH-U
87,800 (6-24)
CH-V
600 (6-24)
CH-W
3,900 (6-24)
Closure
R-22-BC
CH-Wa
8,460 (6-24)
CH-AA
95,800 (6-25)
Closure
CH-LLb
34,900 (6-25)
Partial Closure
L-D
3,960 (6-24)
Lower Grand Bayou
F. W. S.
L-Ga
37,200 (6-25)
CH-BB
58,300 (6-25)
CH-SS
580 (6-25)
Chicot Pass Gage
East Boat Pass
Chicot Pass No.7
7.8 (6-25)
CH-SSc
NO FLOW
CH-SSd
57,000 (6-25)
Chicot Pass No.11
6.7 (6-25)
CH-RR
30,800 (6-25)
CH-RRb
14,500 (6-25)
Charenton N-84
Myette Point
4.5 (6-25)
LOA-NN
31,500 (6-25)
Upper Grand River Dike
F. W. S. N-50-I
Bayou Sorrel Lock
F. W. S. N-50-F
SIMMESPORT
DATE
MEAN DAILY STAGE
COMPUTED Q (PRELIM.)
Not reduced to M.S.L.
WEST COTE BLANCHE BAY
EAST COTE BLANCHE BAY
Calumet
Morgan City
ATCHAFALAYA BAY
GULF OF MEXICO
LEGEND
Est. Estimate
Stream Closure
Recorder Gage
Staff Gage
Special Gage
Discharge Range
RANGE 9 Sedimentation Range
[49342] Station Code No.
Water surface elevations and gage readings have been reduced to National Geodetic Vertical Datum
Flow measurements are in c.f.s.
SCALE OF MILES
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
DISTRIBUTION OF FLOW
RANGES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-24

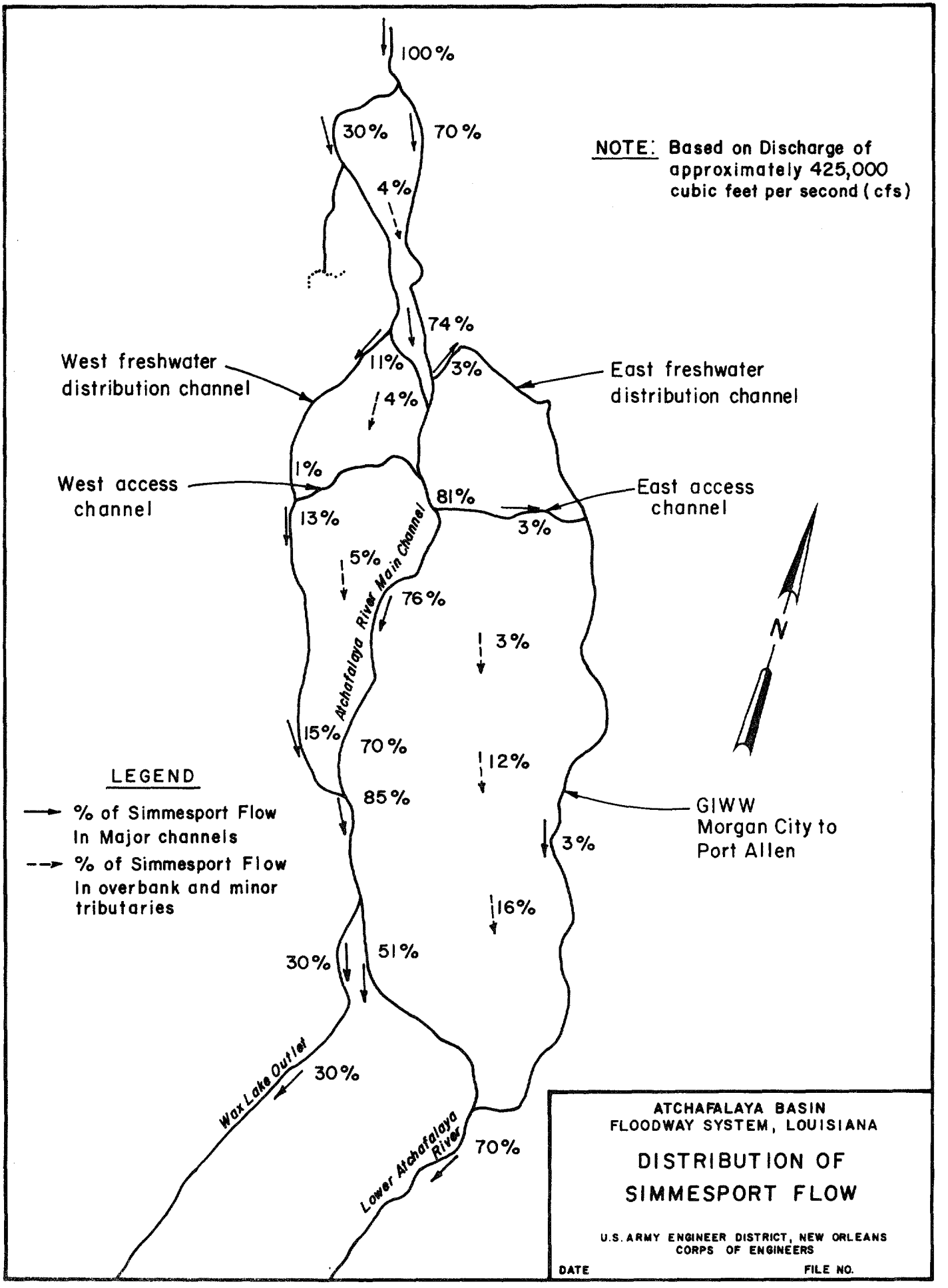
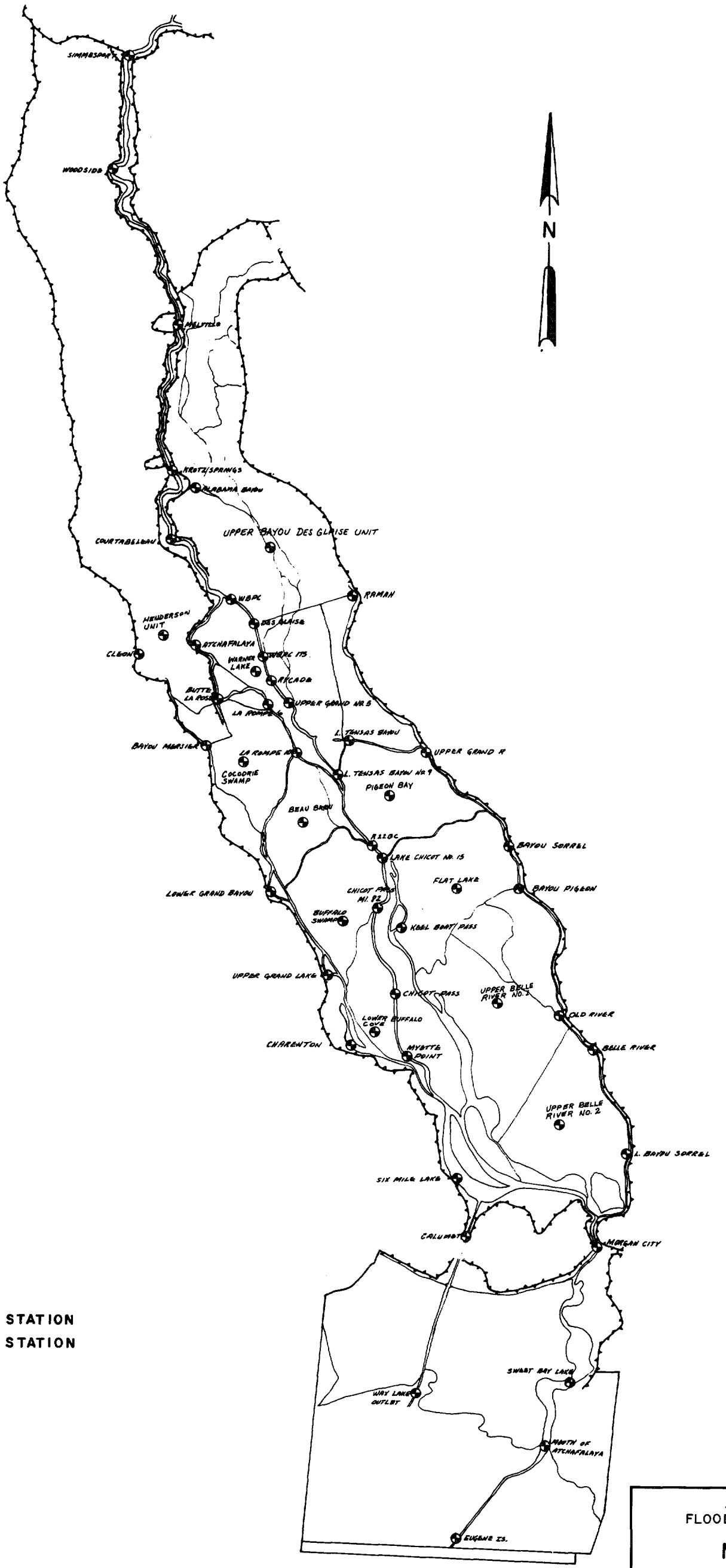

100%
30%
70%
4%
74%
West freshwater distribution channel
11%
3%
East freshwater distribution channel
4%
1%
West access channel
81%
East access channel
13%
3%
5%
Atchafalaya River Main Channel
76%
3%
15%
70%
12%
85%
GIWW Morgan City to Port Allen
3%
16%
30%
51%
Wax Lake Outlet
30%
Lower Atchafalaya River
70%
N
LEGEND
% of Simmesport Flow In Major channels
% of Simmesport Flow In overbank and minor tributaries
NOTE: Based on Discharge of approximately 425,000 cubic feet per second (cfs)
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
DISTRIBUTION OF
SIMMESPORT FLOW
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-25



LEGEND

● GAGING STATION

▲ LEVEE STATION

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

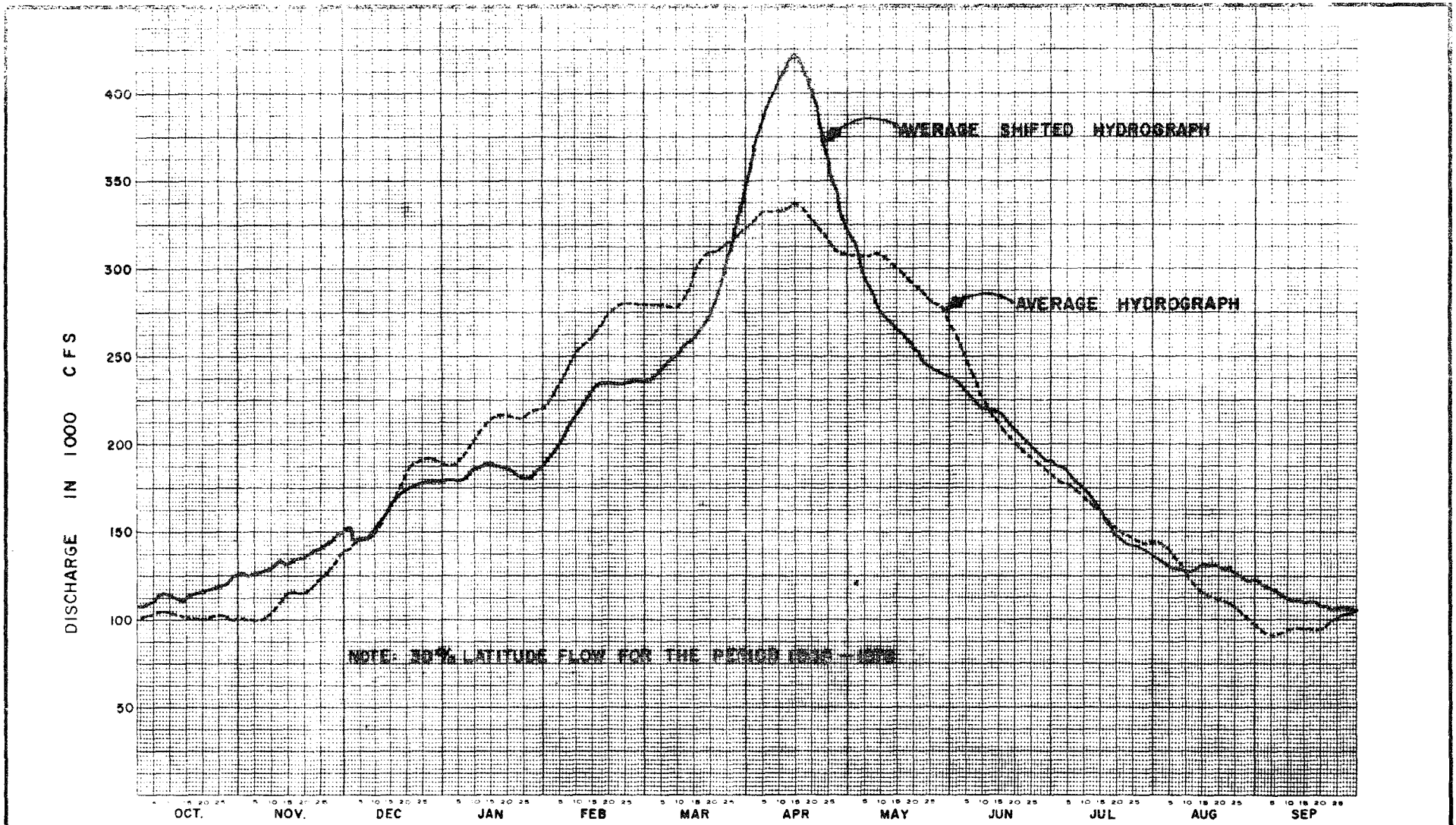
MBM GAGES LOCATION MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-26

PLATE C-26



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

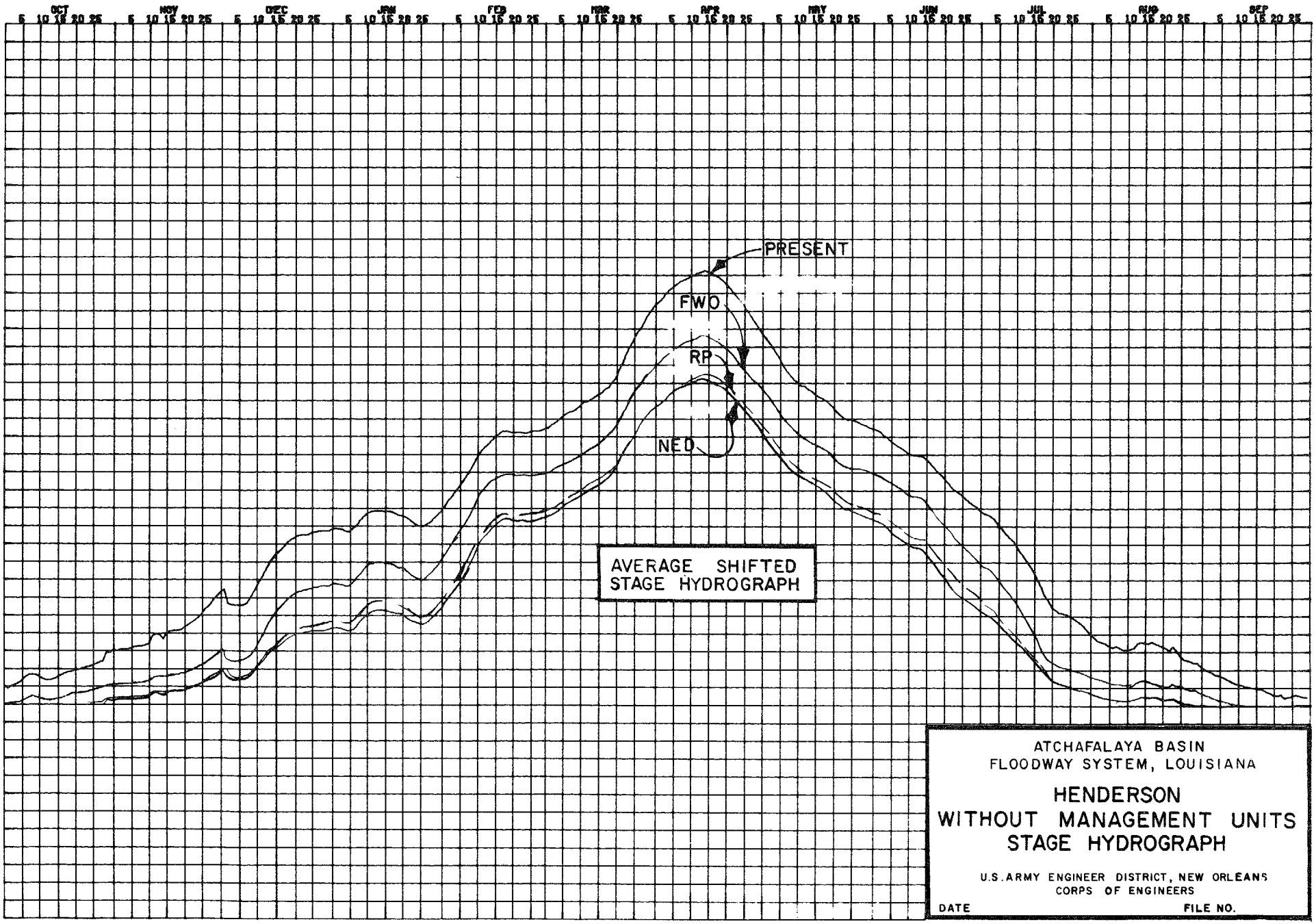
ATCHAFALAYA RIVER DISCHARGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-27

PLATE C-27



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

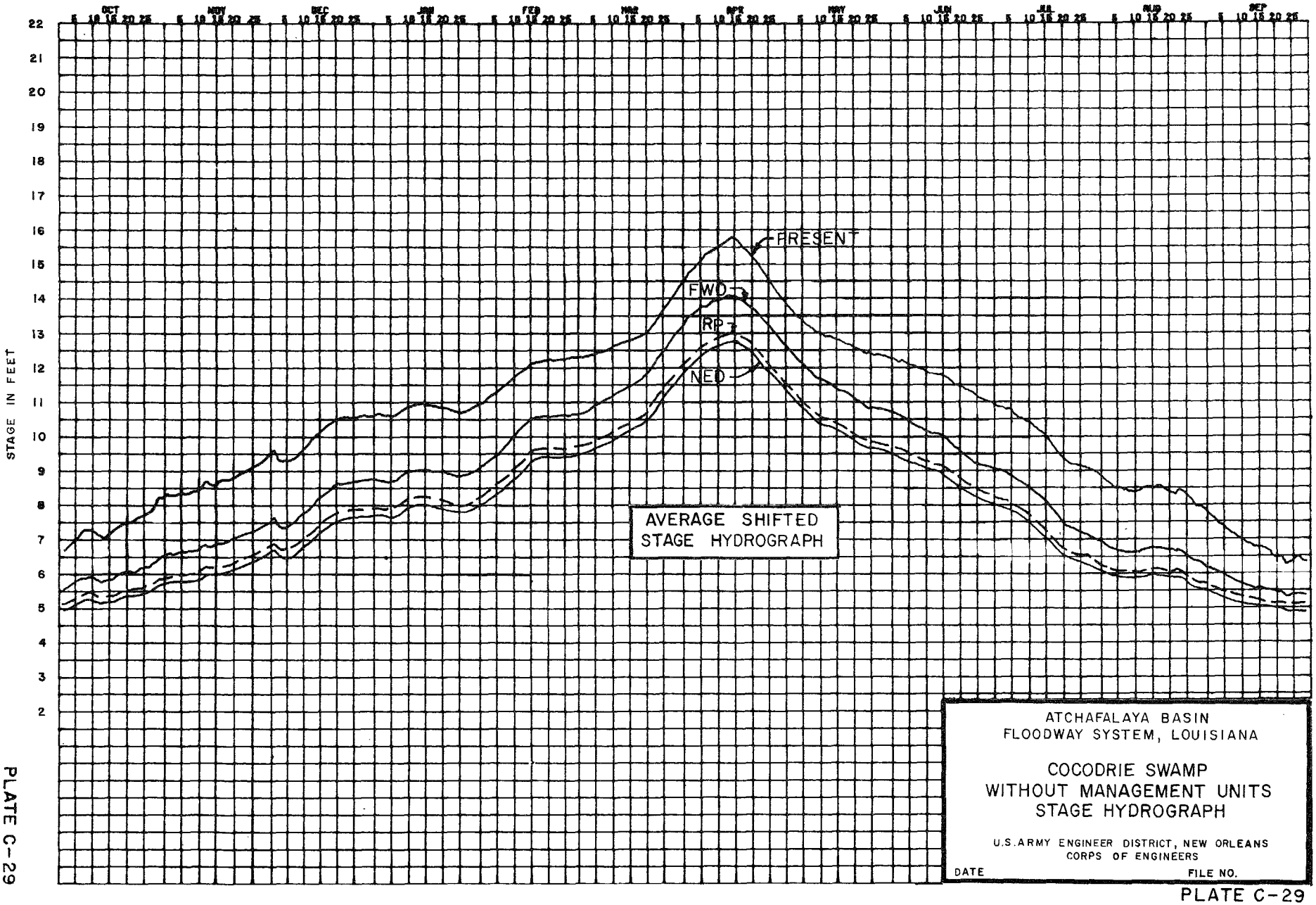
HENDERSON
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-28

PLATE C-28



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

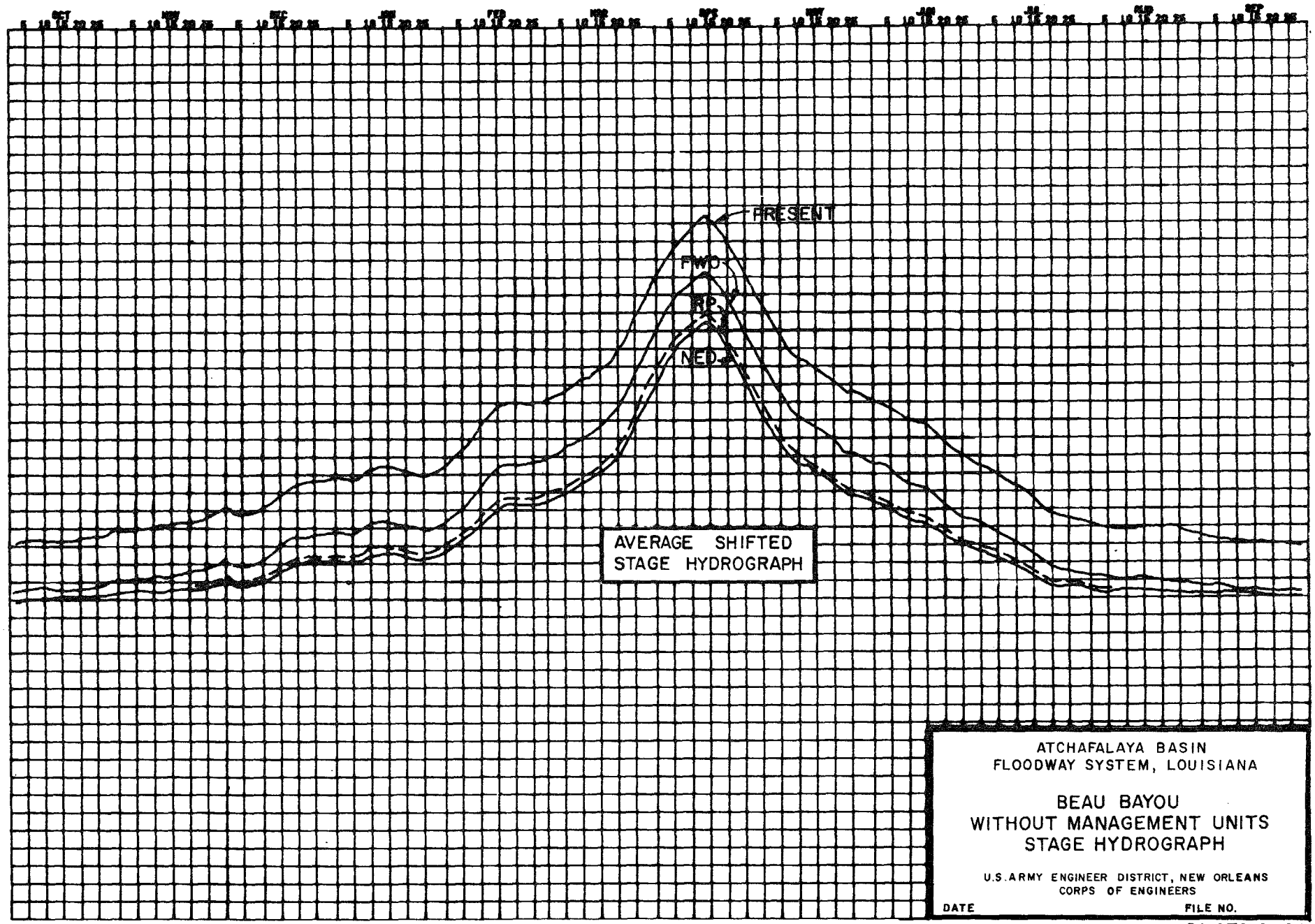
COCODRIE SWAMP
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-29

PLATE C-29



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

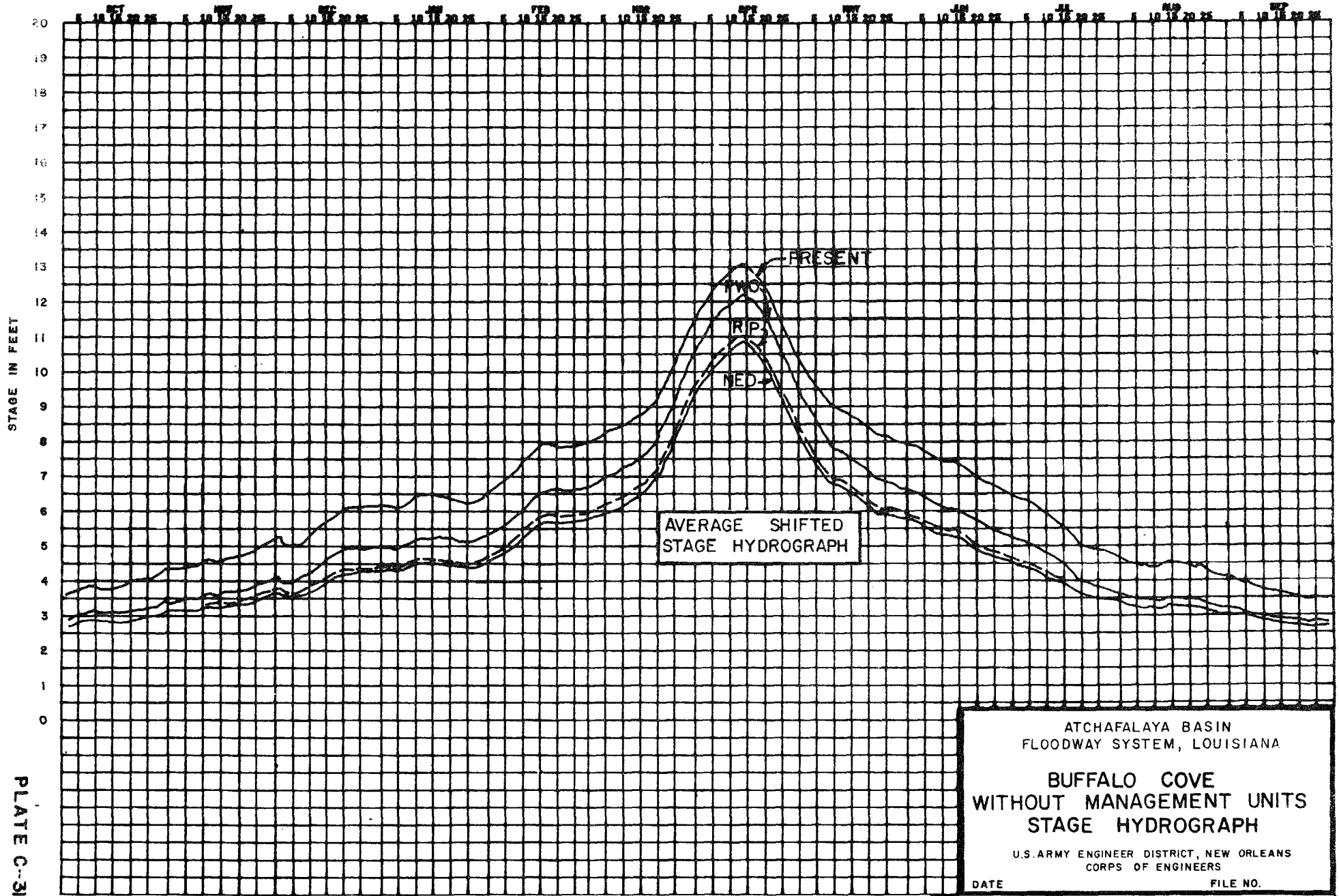
BEAU BAYOU
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-30

PLATE C-30



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

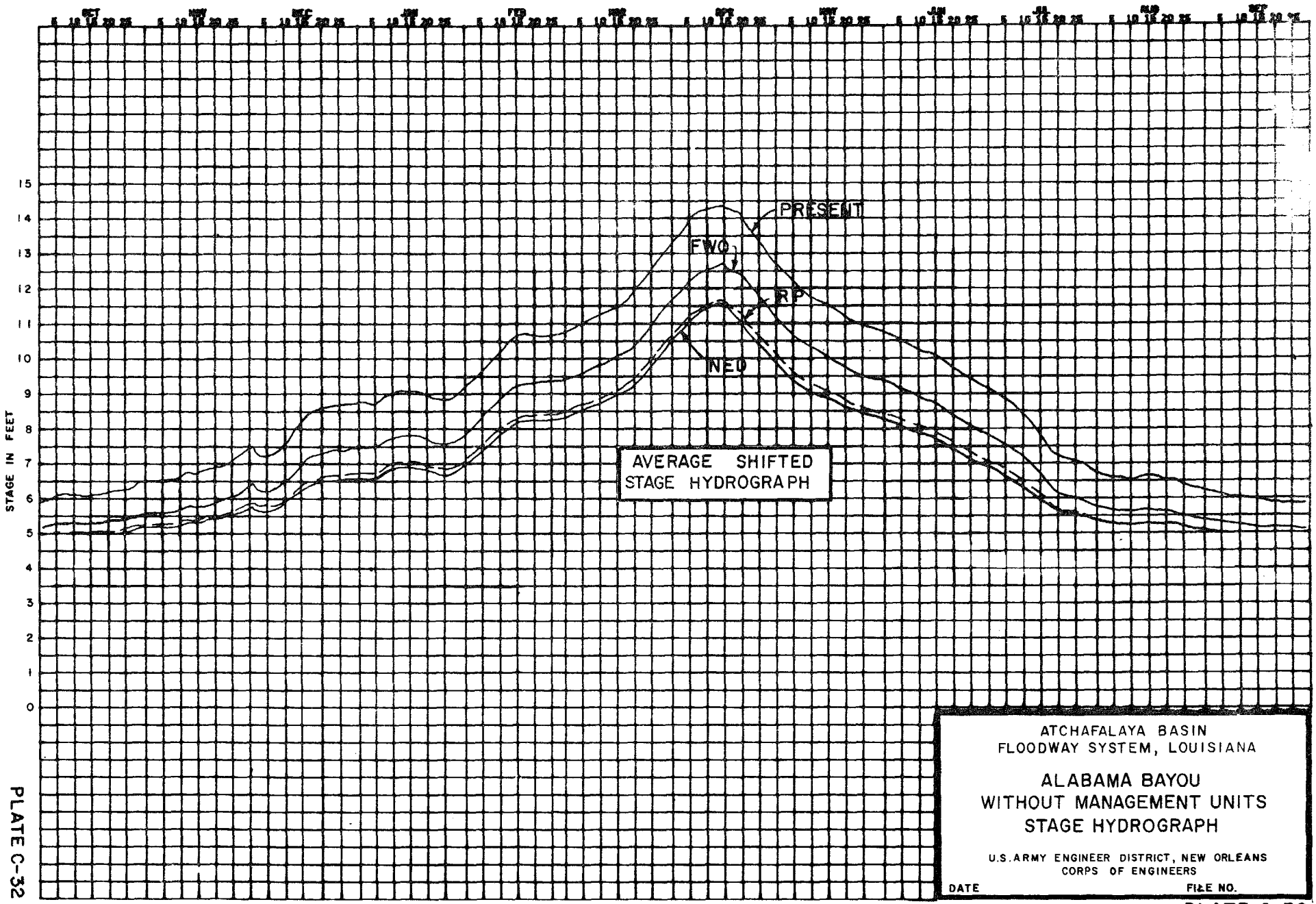
BUFFALO COVE
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-31

PLATE C-31



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

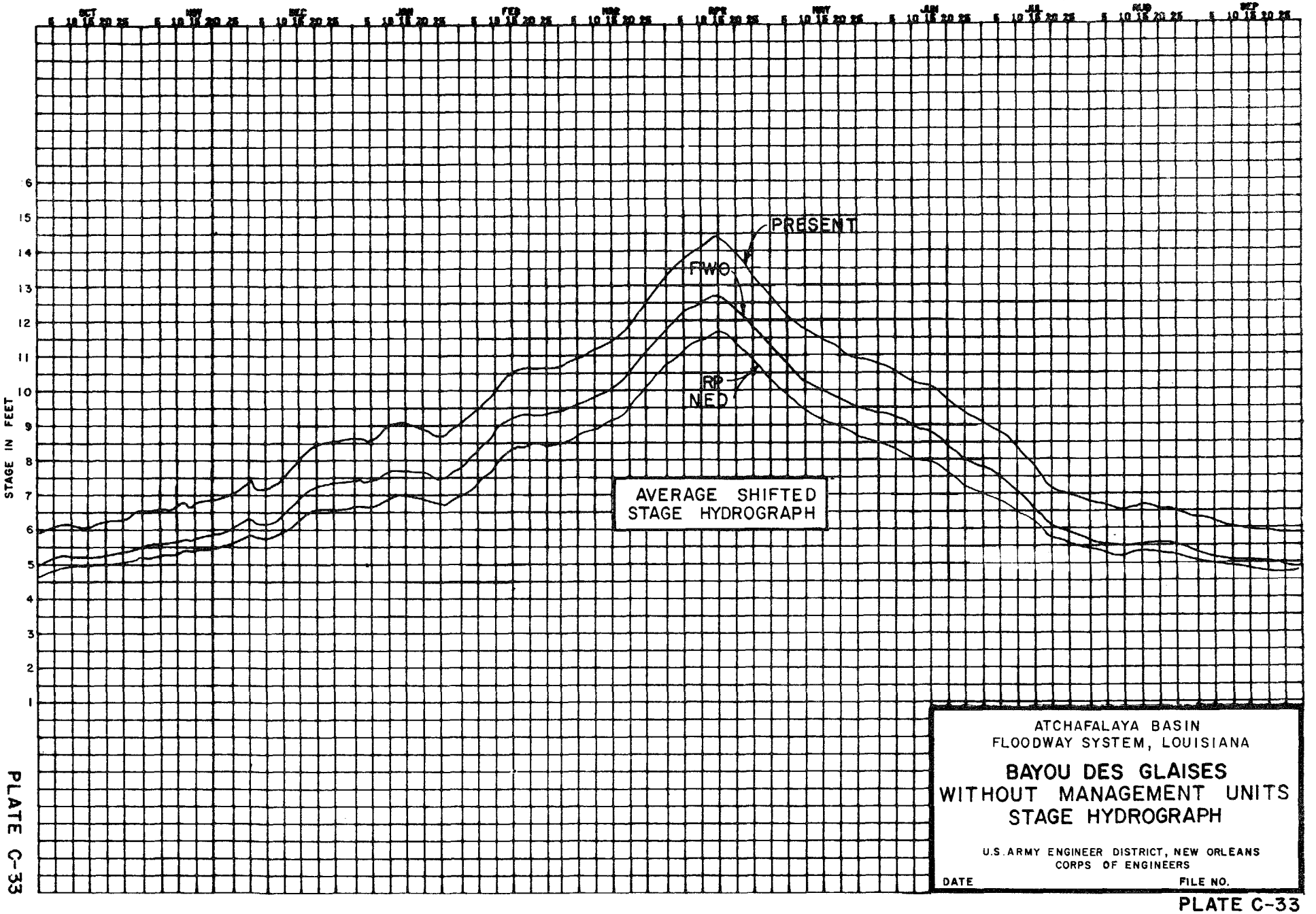
ALABAMA BAYOU
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-32

PLATE C-32



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

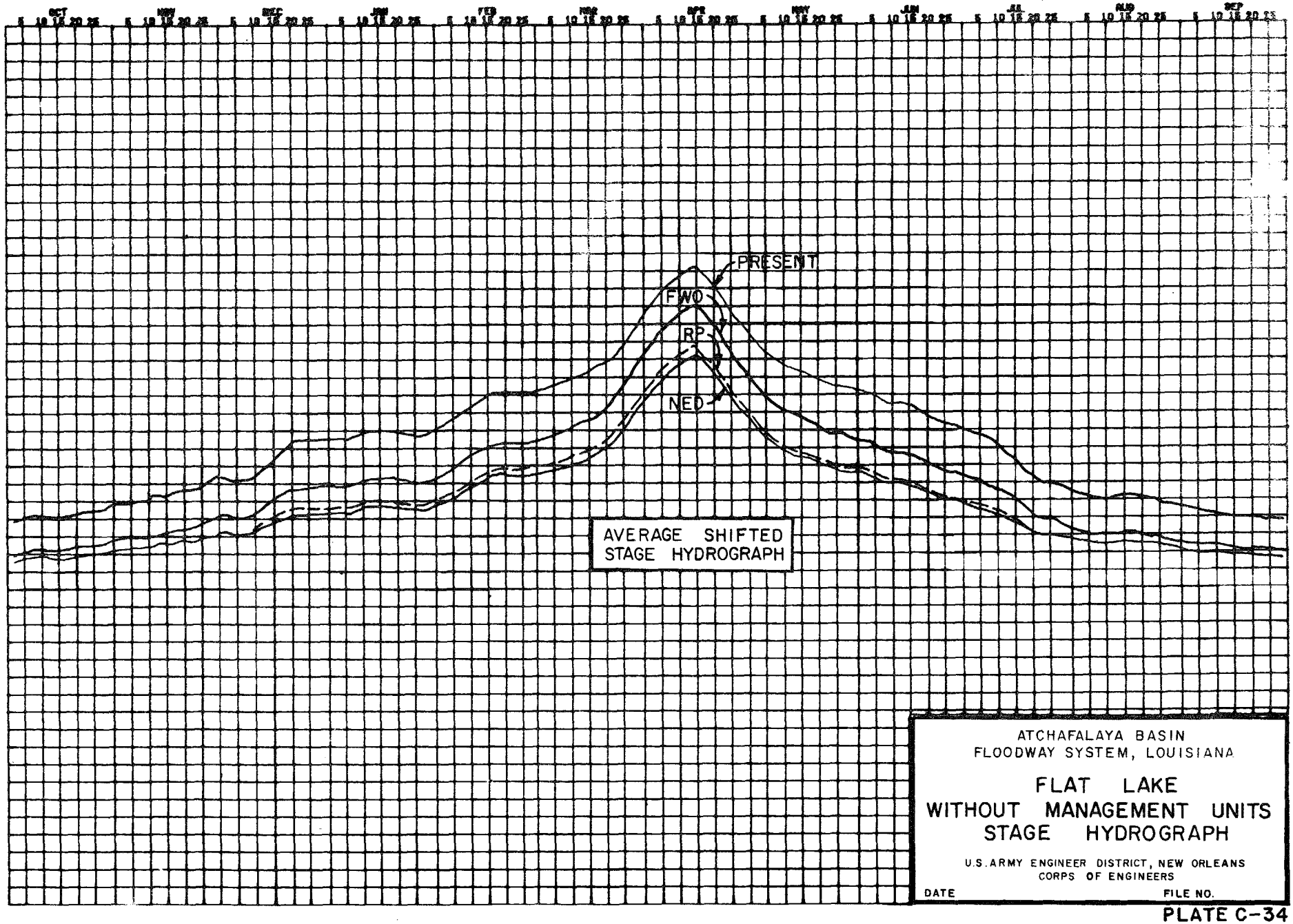
BAYOU DES GLAISES
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-33

PLATE C-33



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

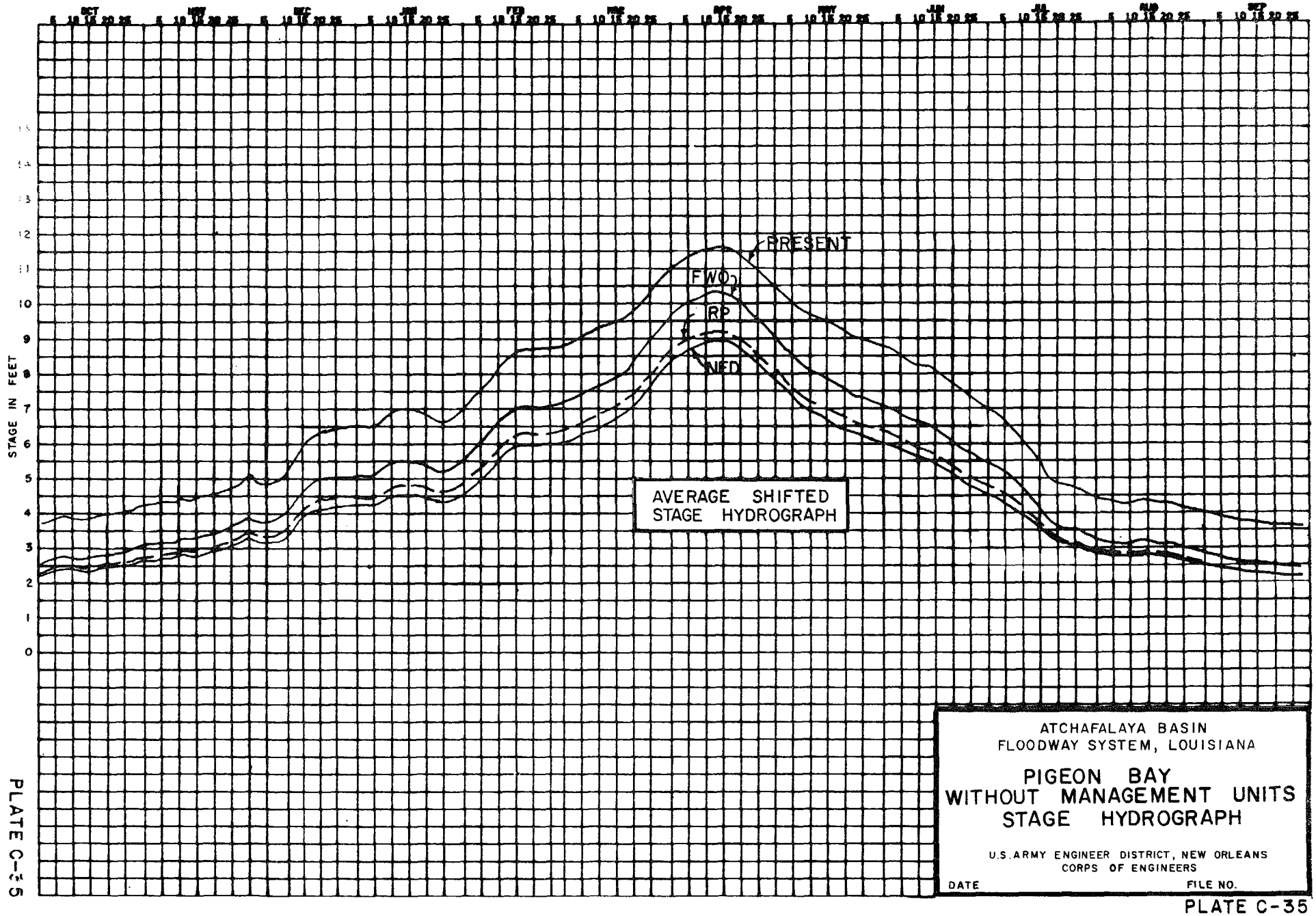
FLAT LAKE
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-34

PLATE C-34



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

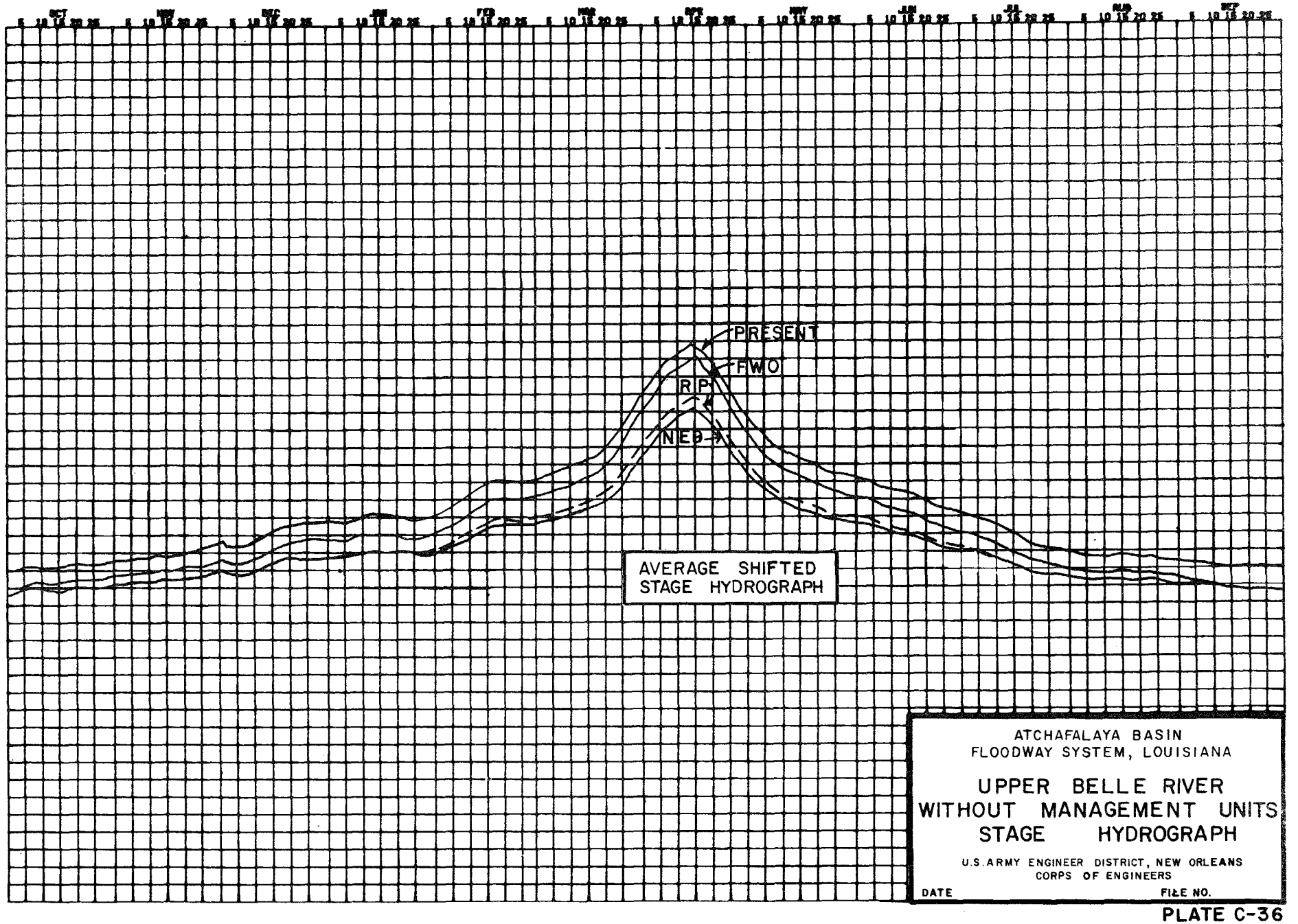
PIGEON BAY
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-35

PLATE C-35



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

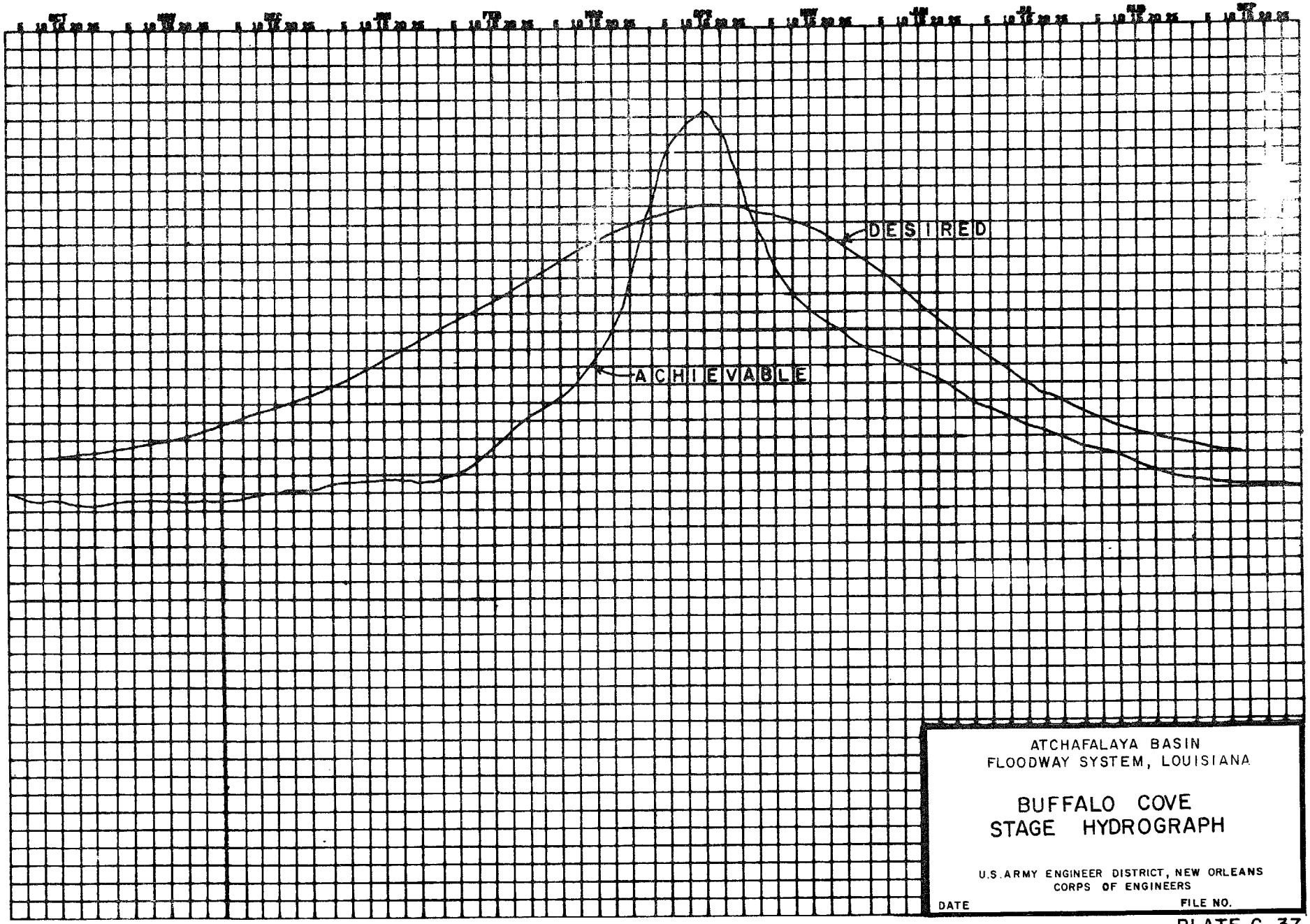
UPPER BELLE RIVER WITHOUT MANAGEMENT UNITS STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-36

PLATE C-36



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BUFFALO COVE
STAGE HYDROGRAPH

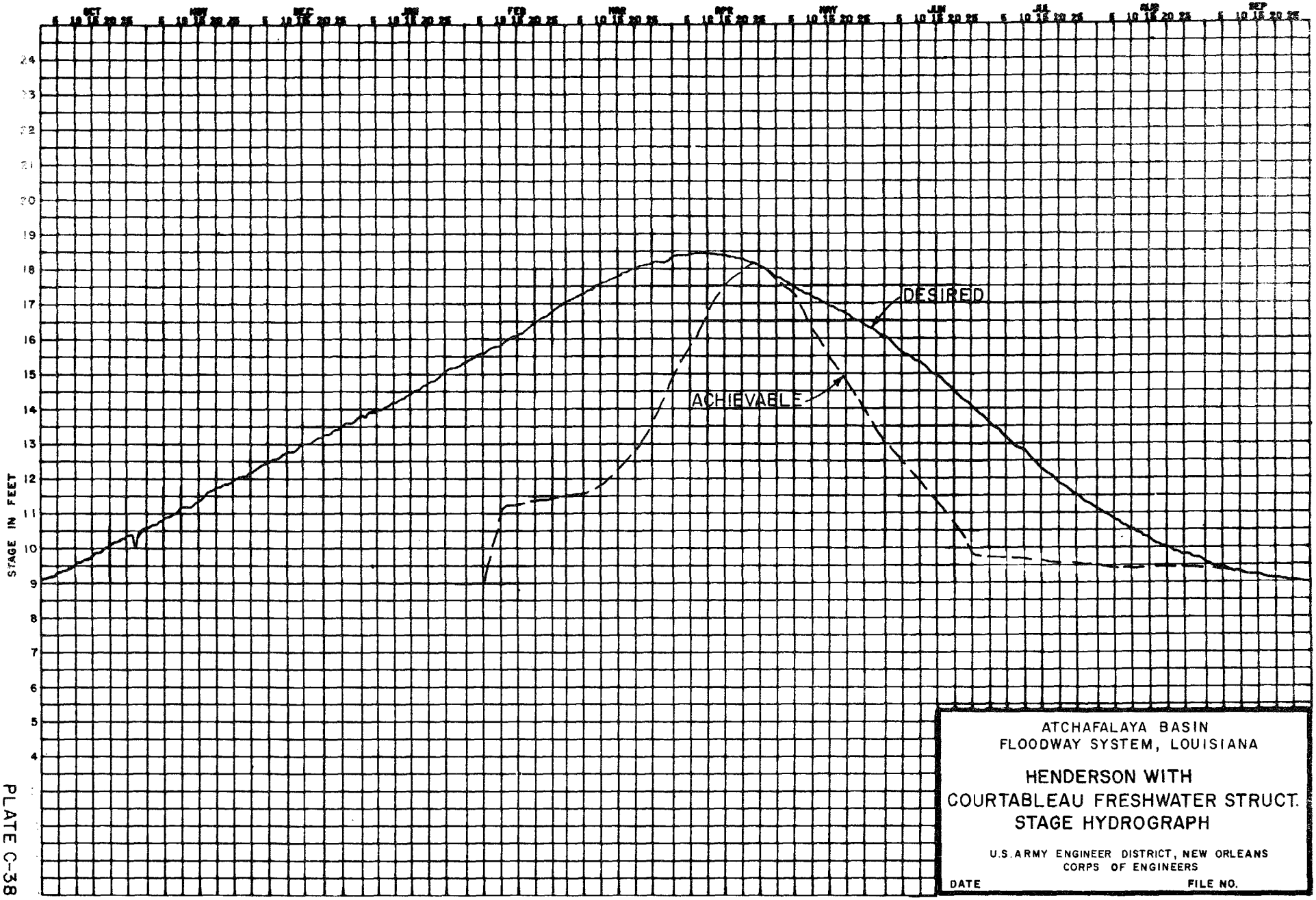
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE C-37

PLATE C-37



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

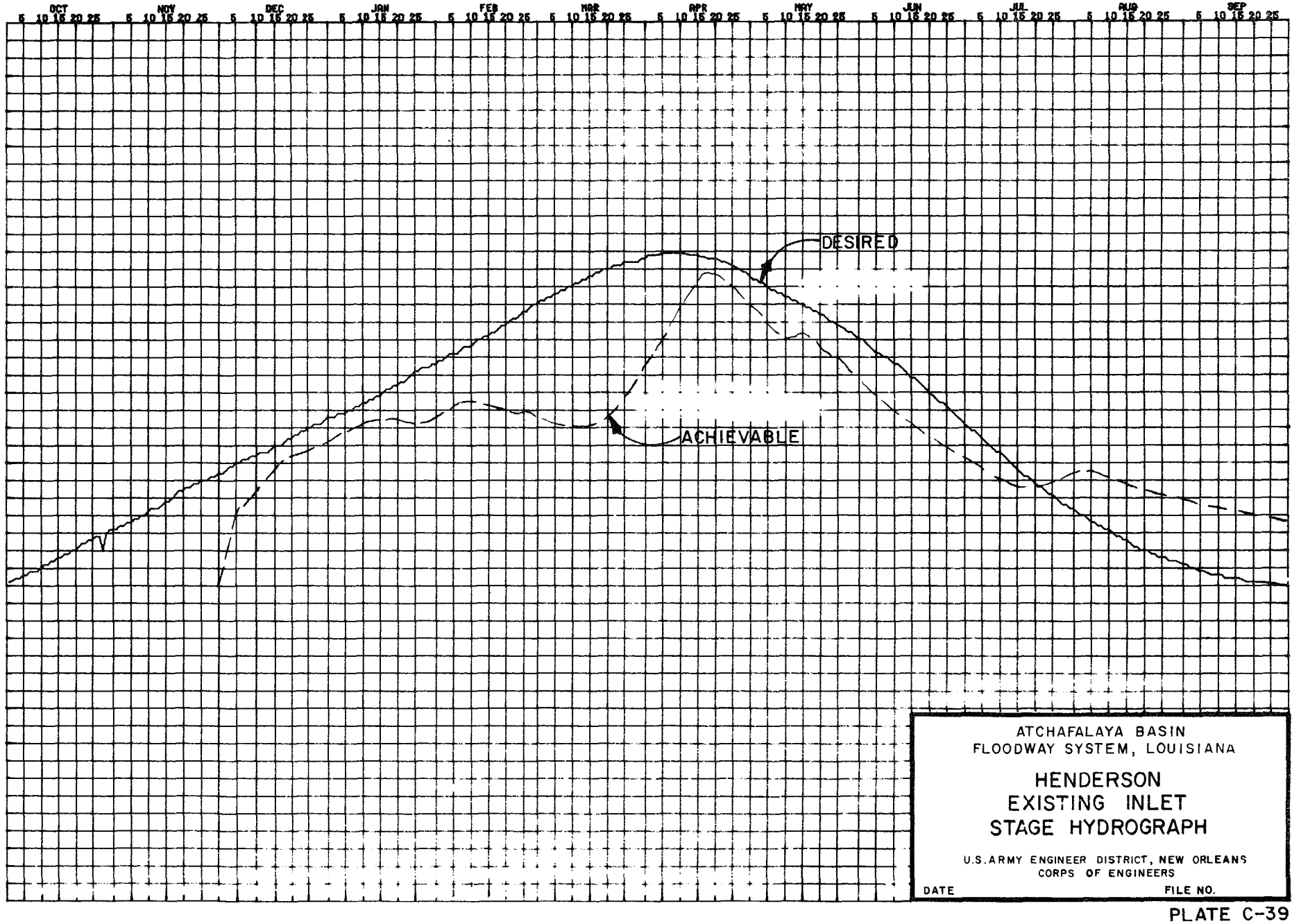
HENDERSON WITH
COURTABLEAU FRESHWATER STRUCT.
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-38

PLATE C-38



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

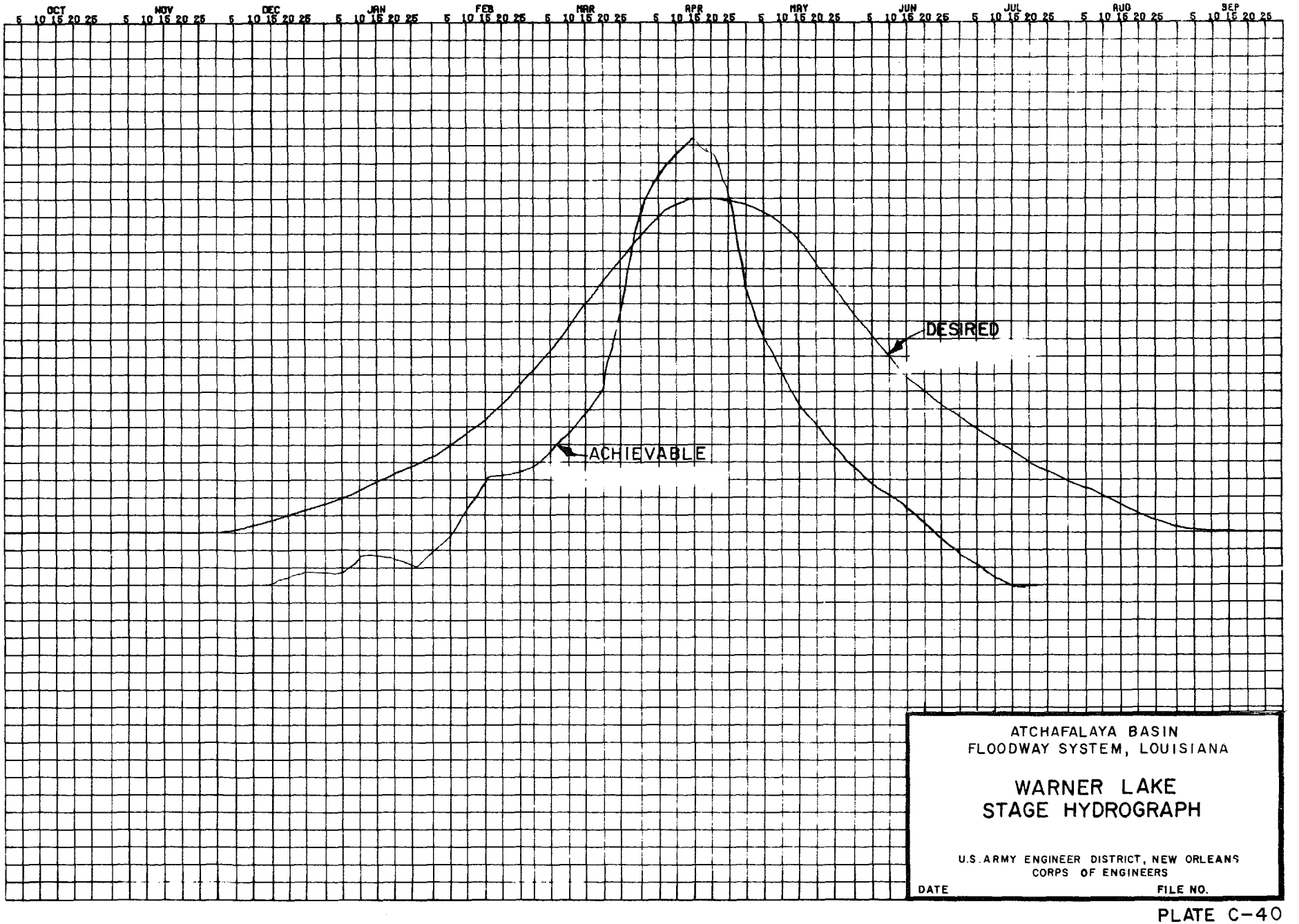
HENDERSON
EXISTING INLET
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-39

PLATE C-39



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

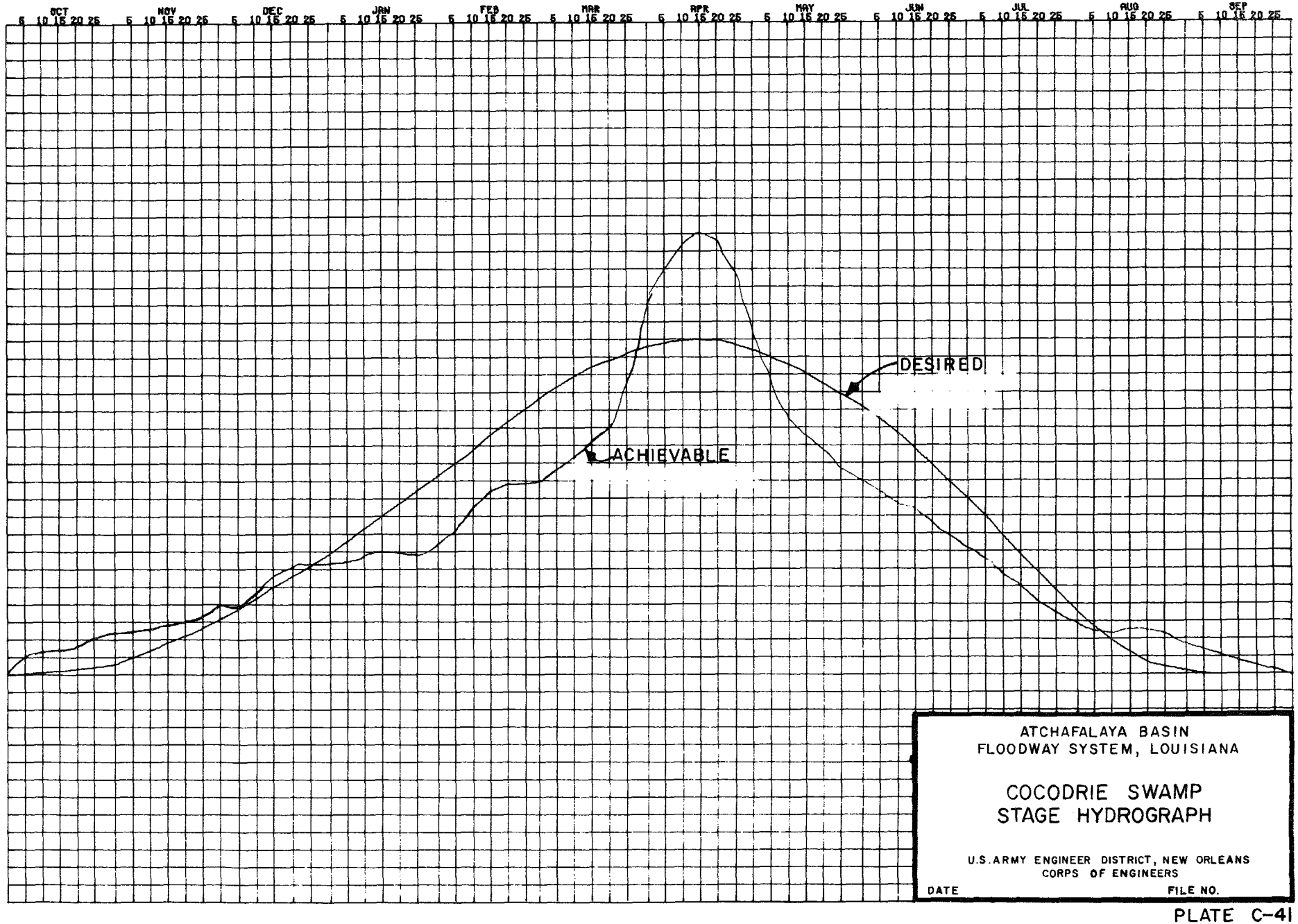
WARNER LAKE
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-40

PLATE C-40



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

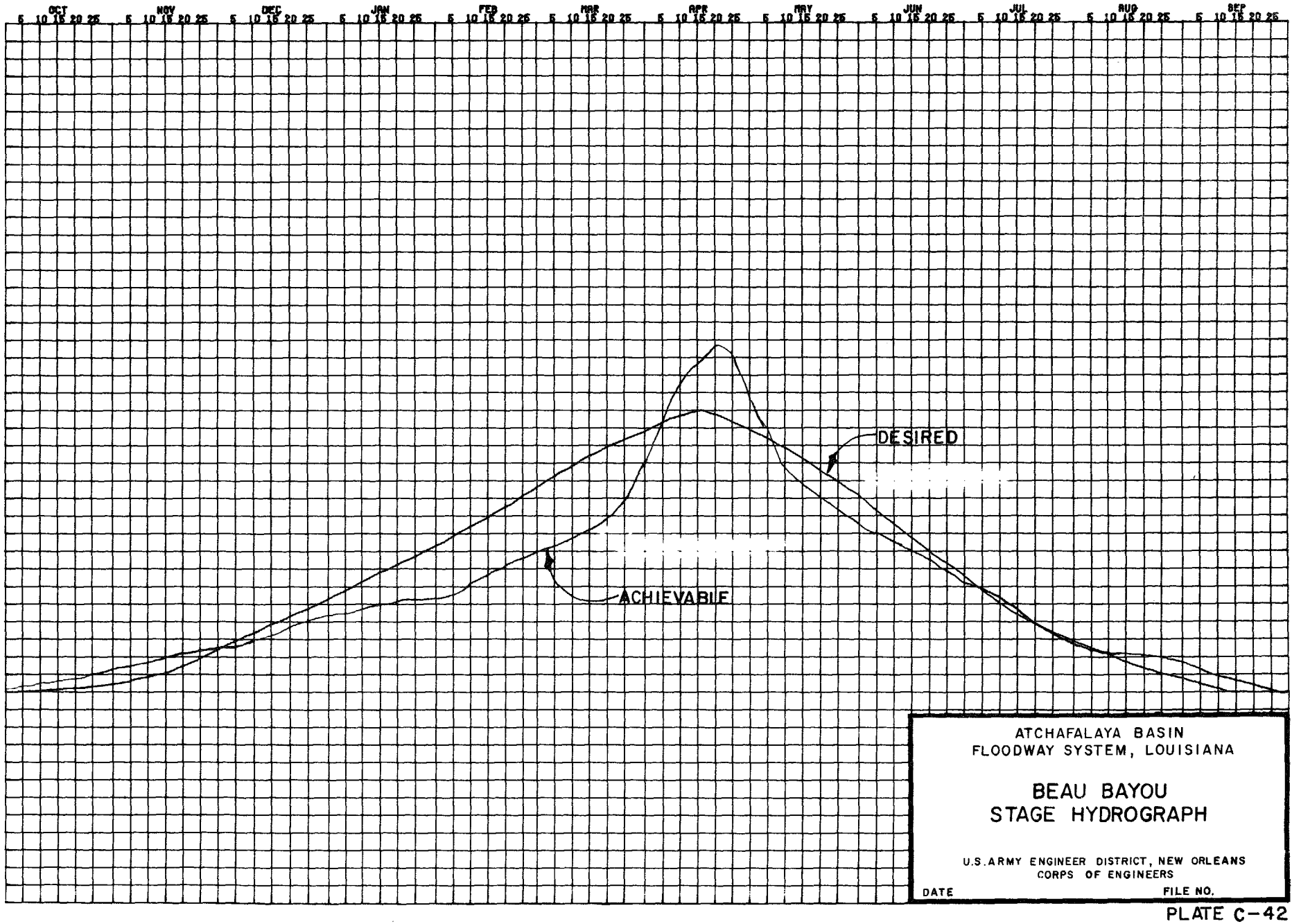
COCODRIE SWAMP
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-41

PLATE C-41



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

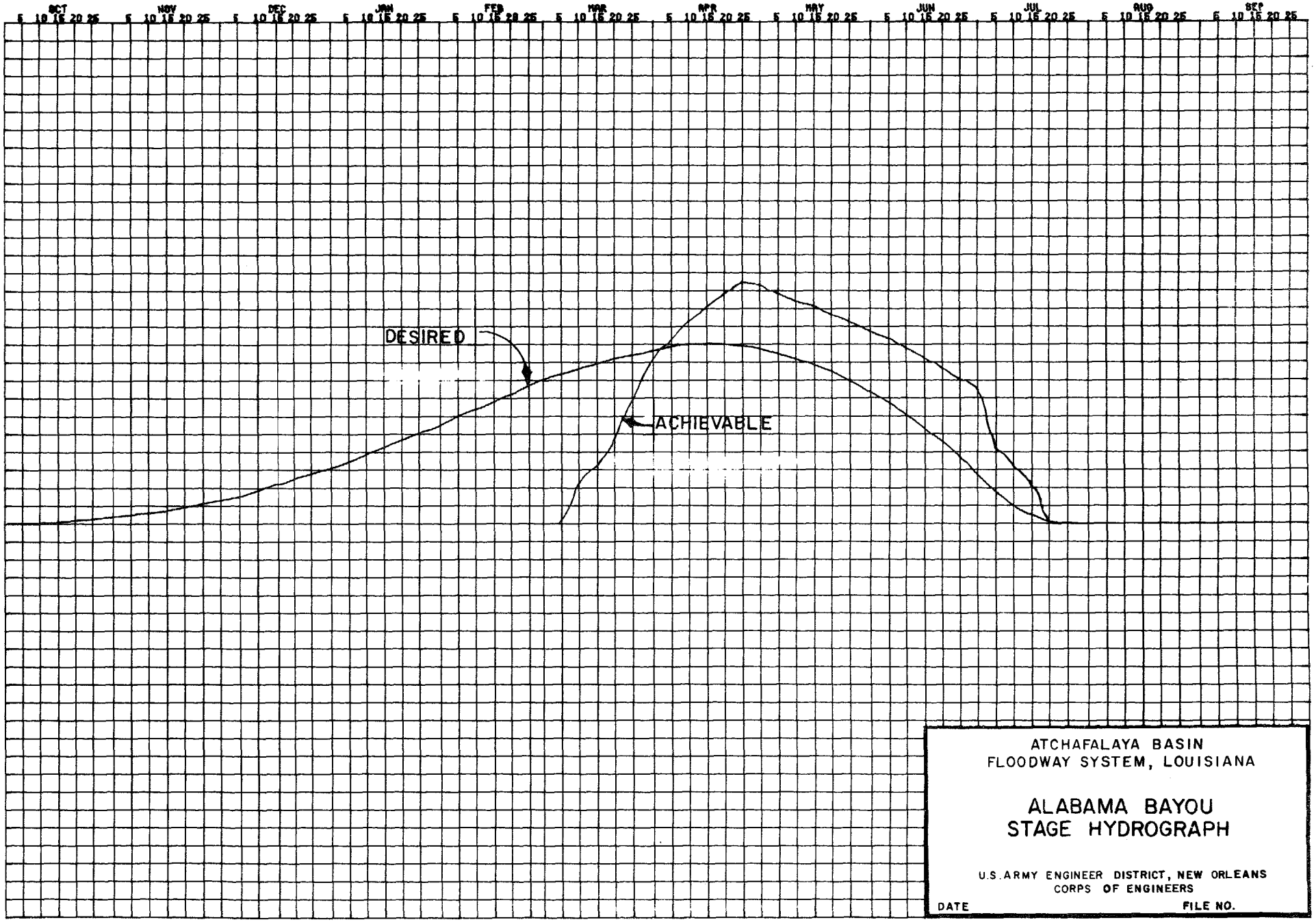
BEAU BAYOU
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-42

PLATE C-42



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

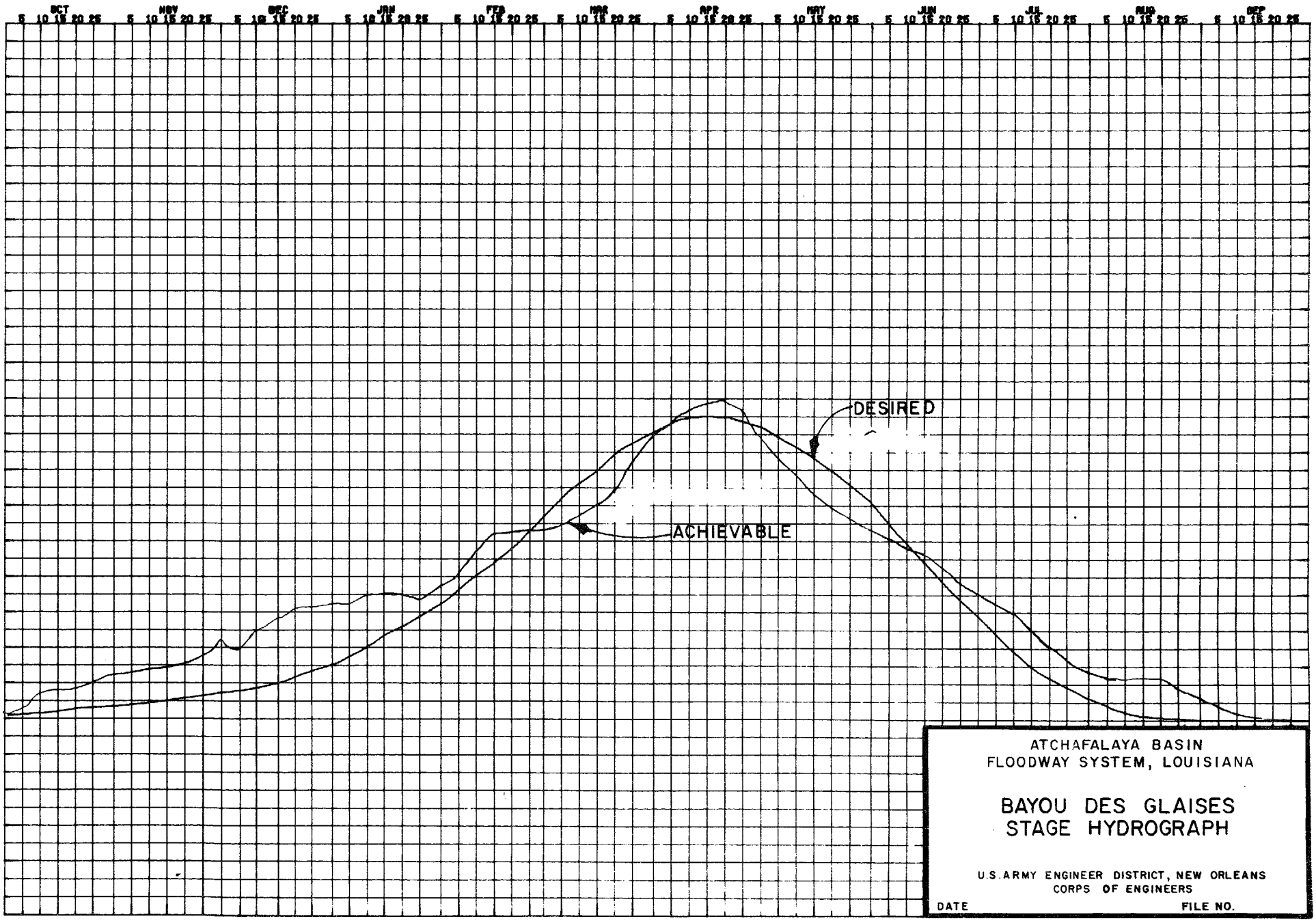
ALABAMA BAYOU
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-43

PLATE C-43



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

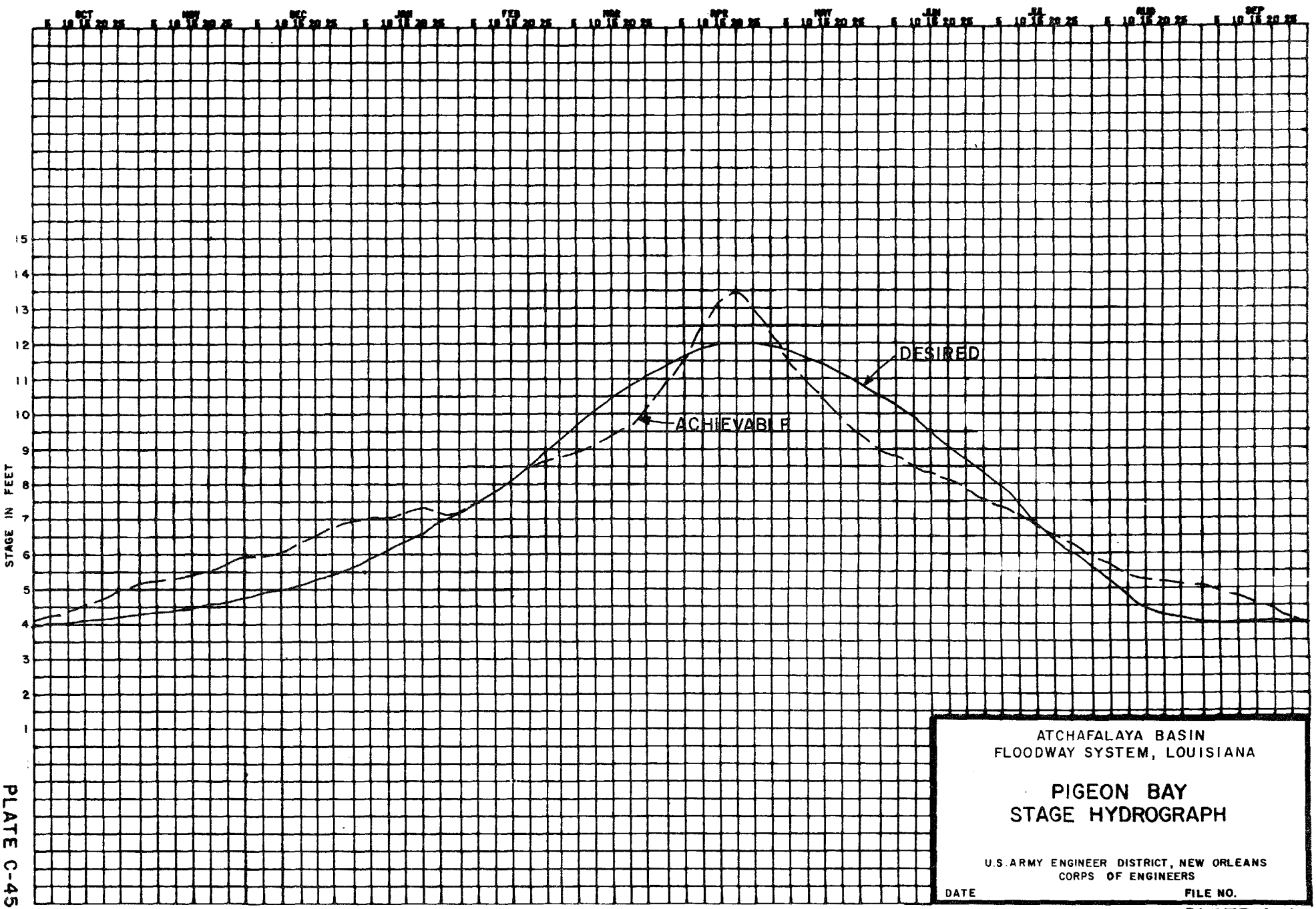
BAYOU DES GLAISES
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-44

PLATE C-44



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

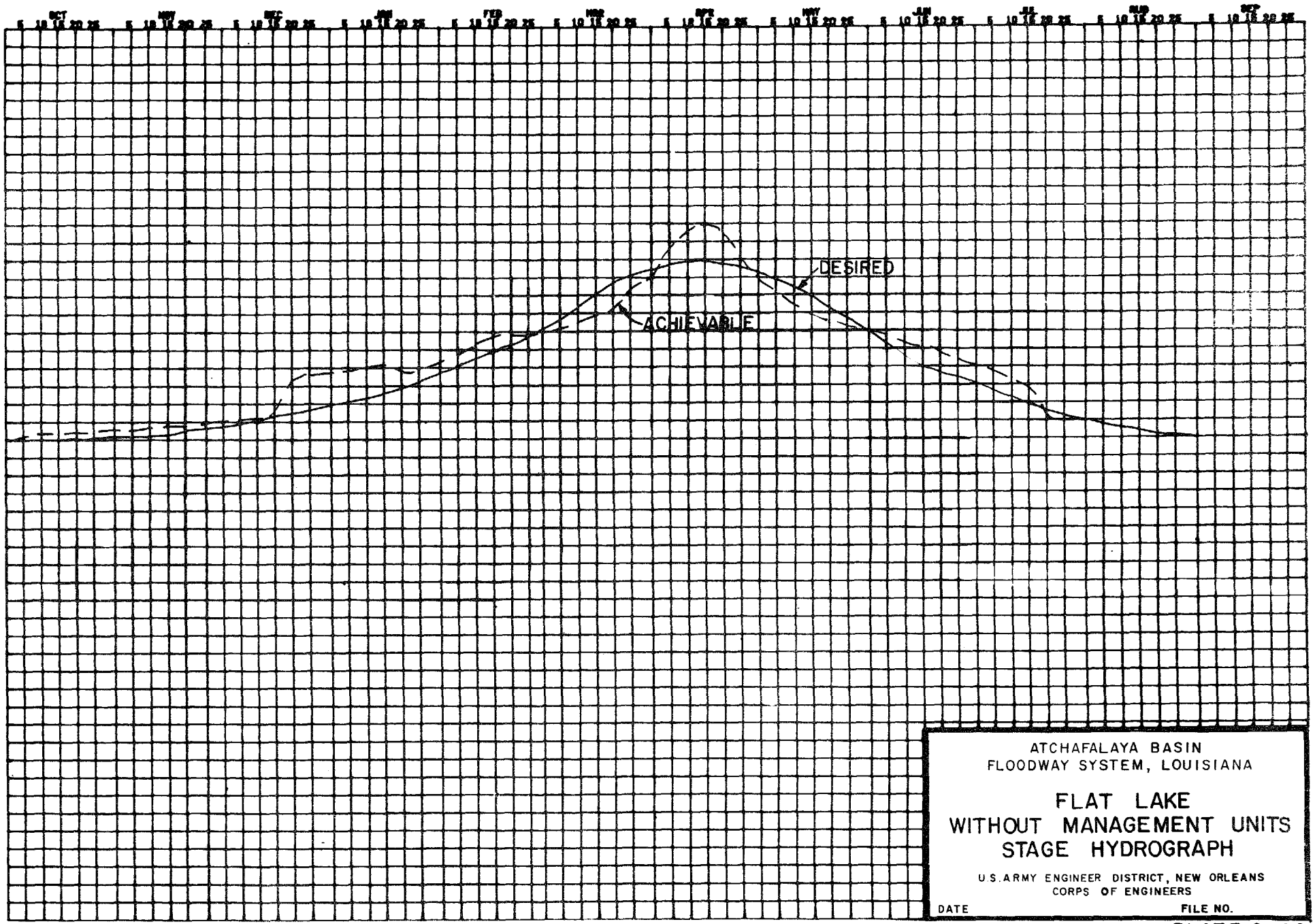
PIGEON BAY
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-45

PLATE C-45



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

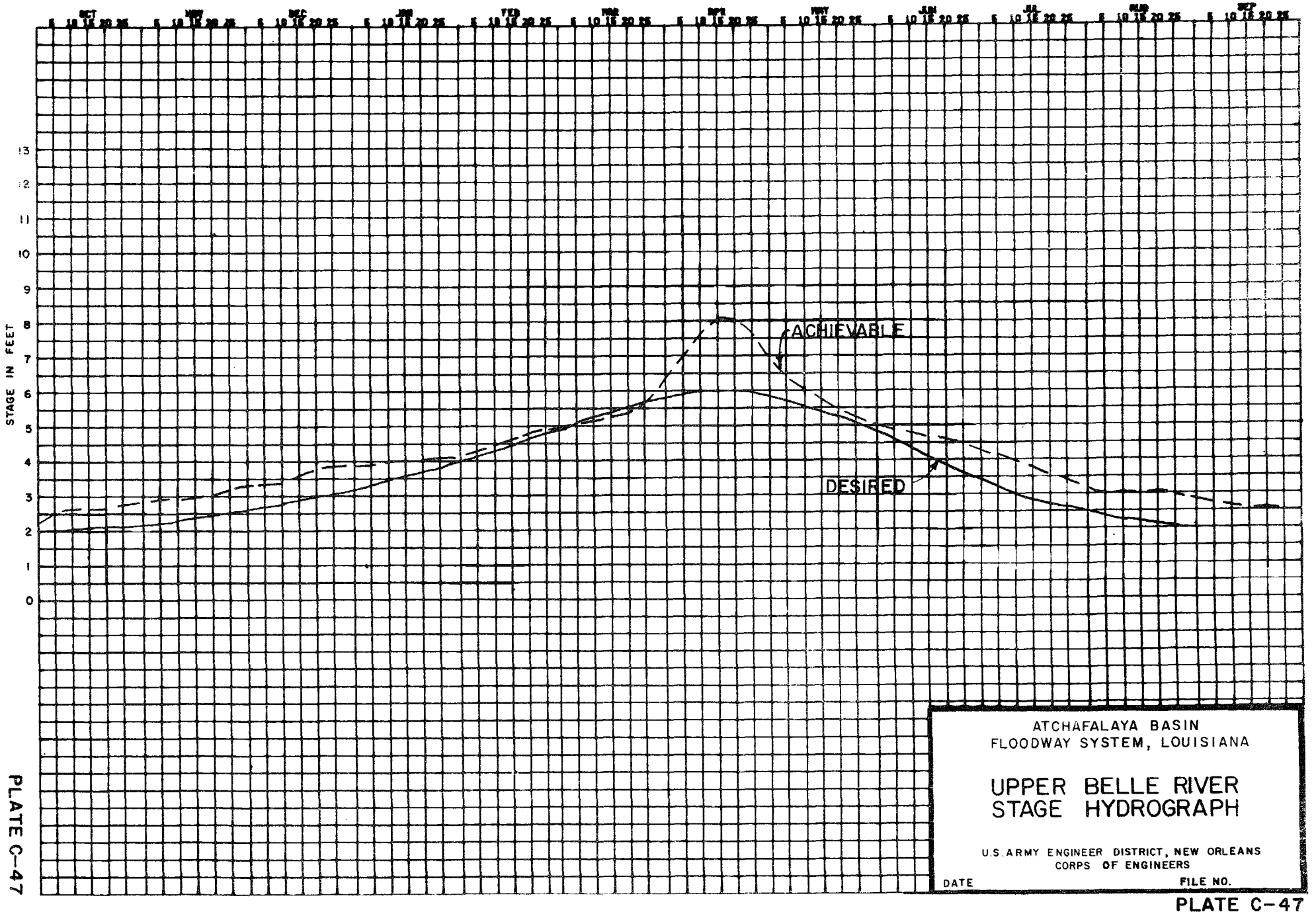
FLAT LAKE
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-46

PLATE C-46



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

UPPER BELLE RIVER
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE C-47

PLATE C-47

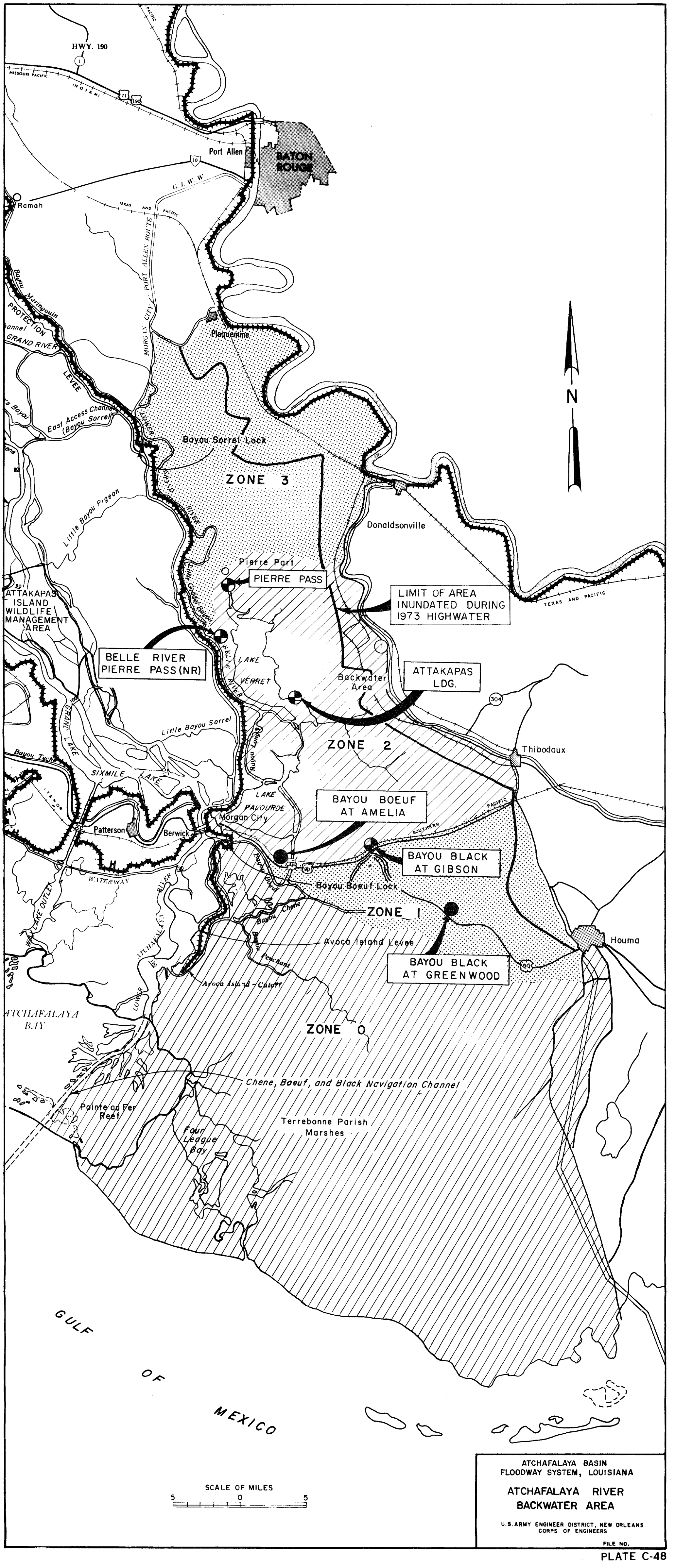
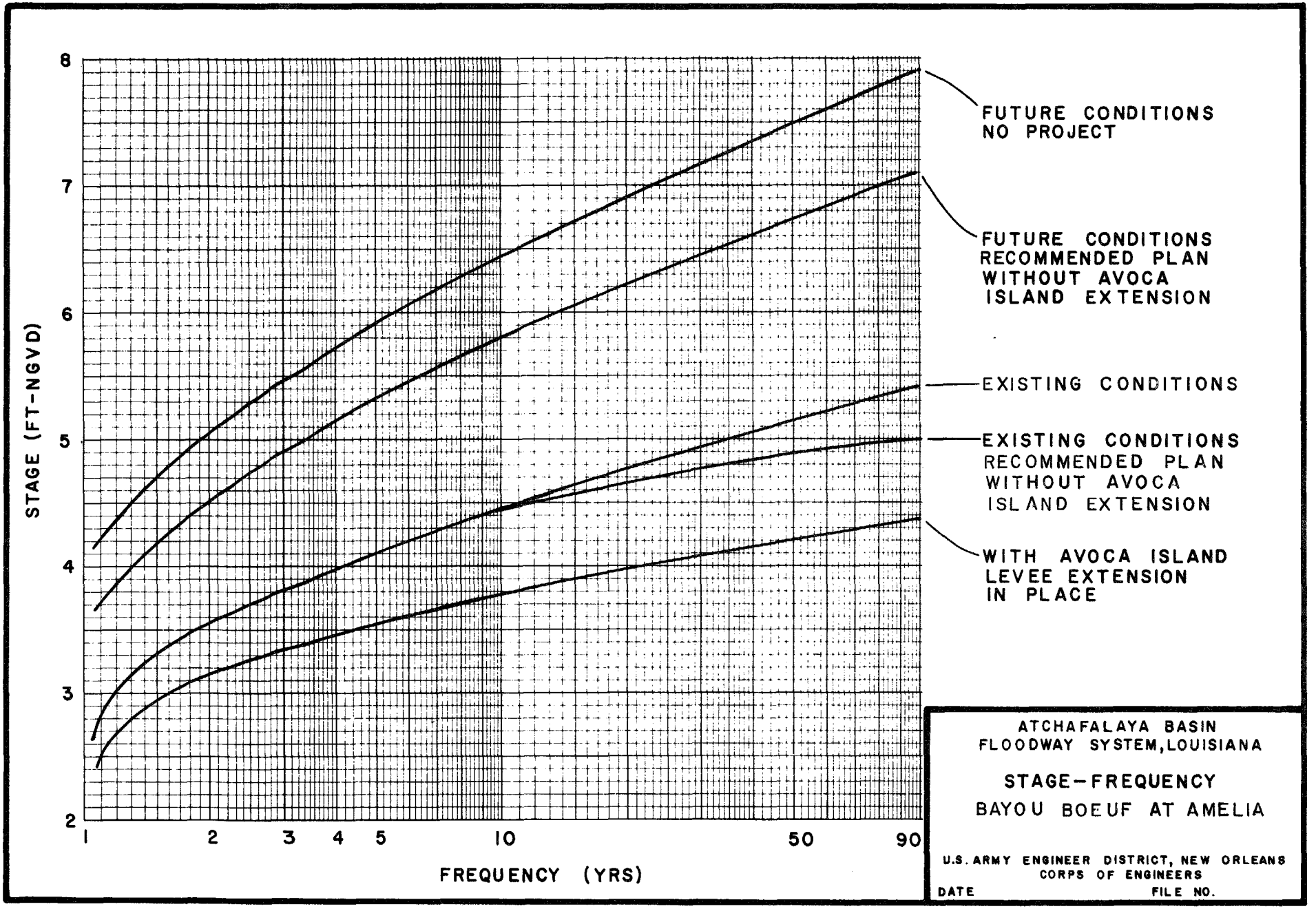


PLATE C-48

PLATE C-48



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

STAGE–FREQUENCY

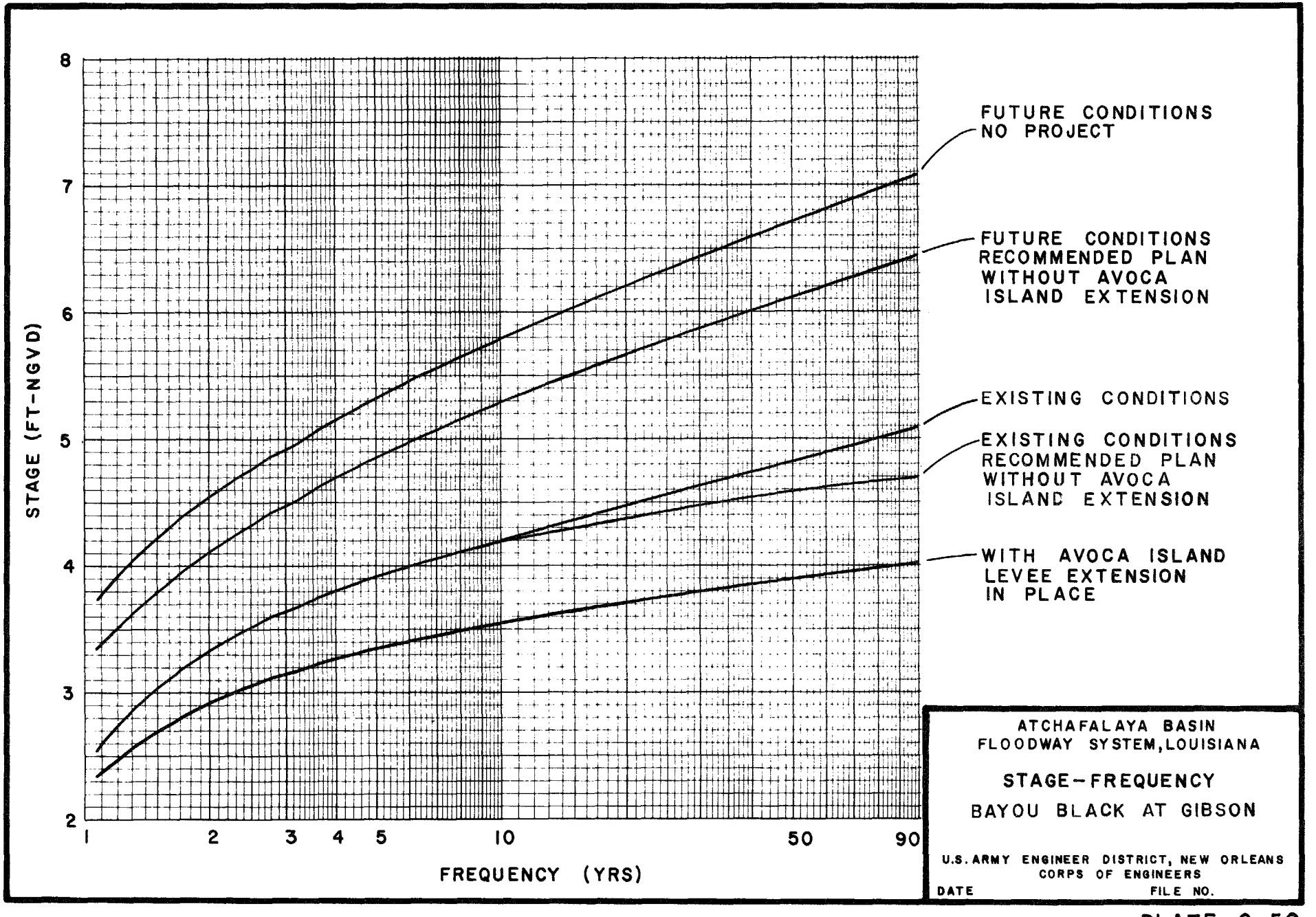
BAYOU BOEUF AT AMELIA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-49

PLATE C-49



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

STAGE-FREQUENCY

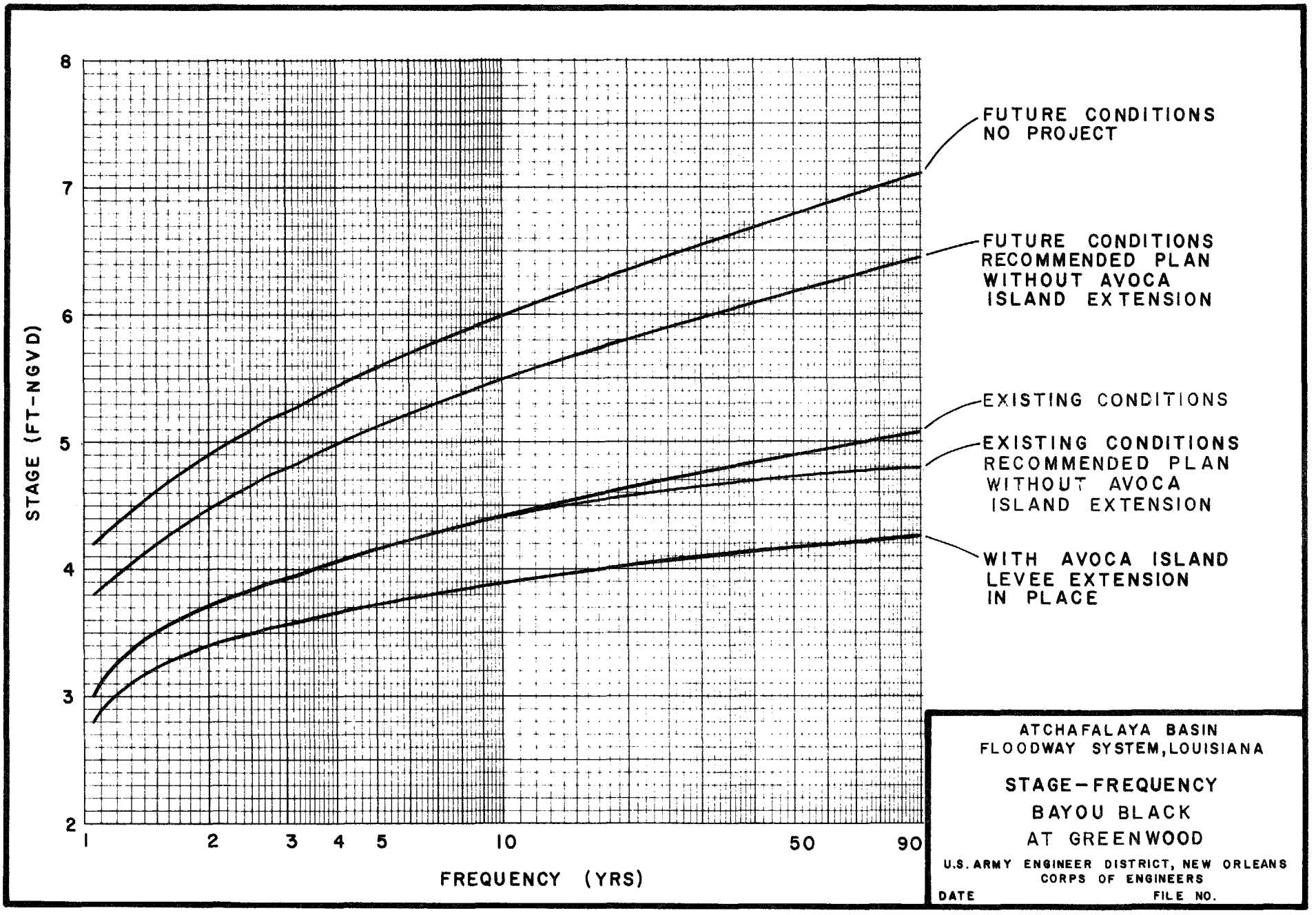
BAYOU BLACK AT GIBSON

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-50

PLATE C-50



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

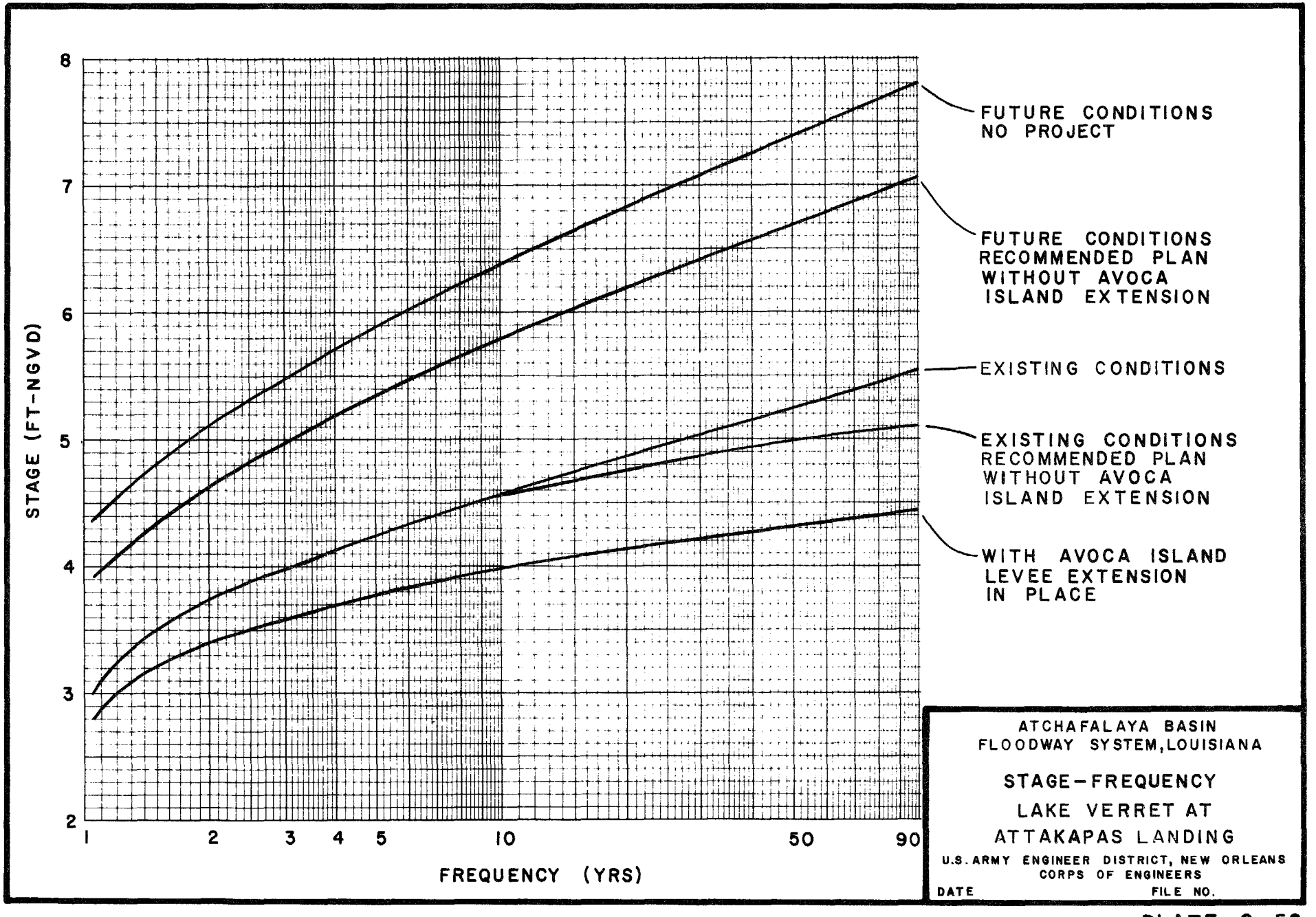
STAGE-FREQUENCY
BAYOU BLACK
AT GREENWOOD

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-51

PLATE C-51



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

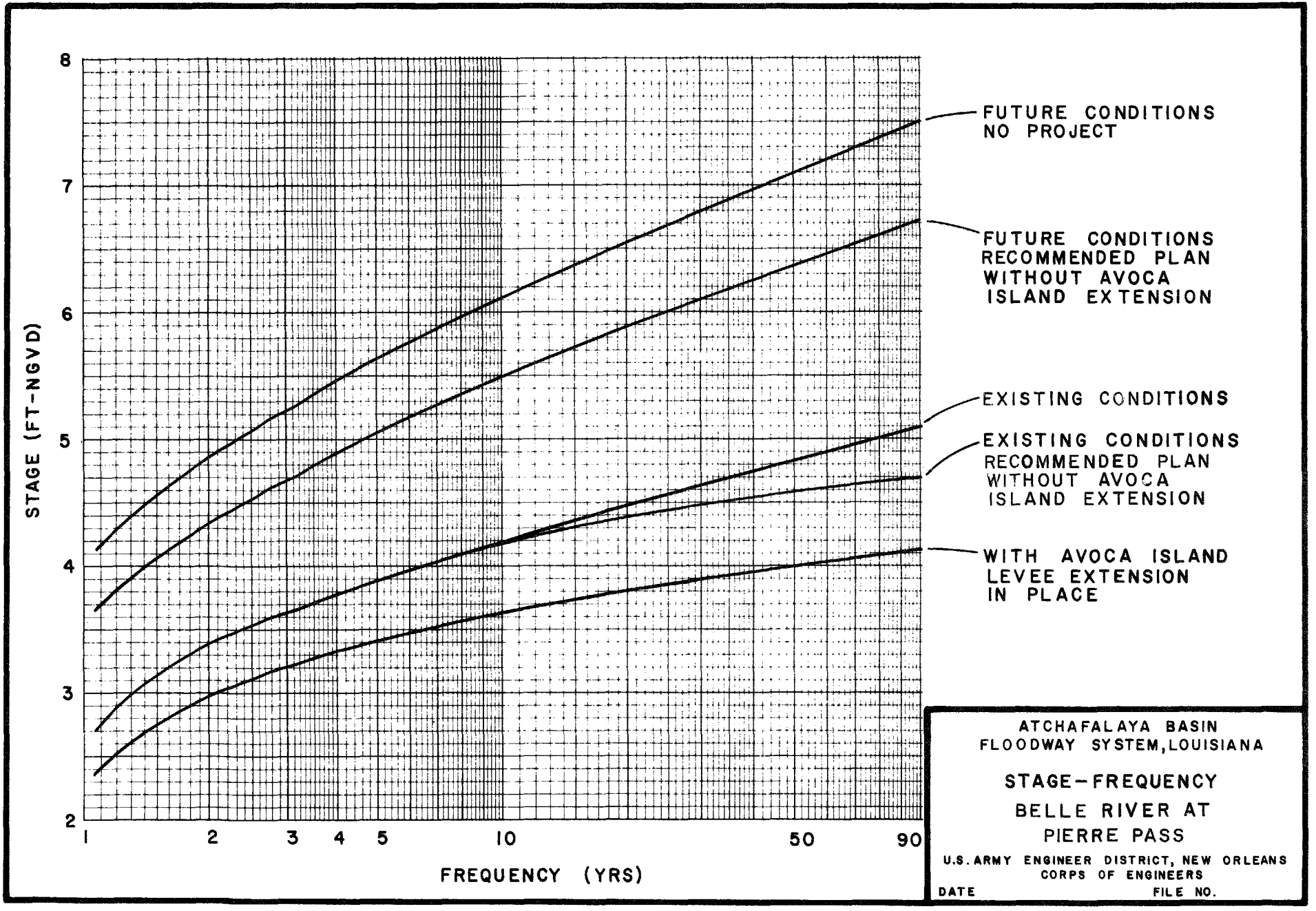
STAGE-FREQUENCY
LAKE VERRET AT
ATTAKAPAS LANDING

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-52

PLATE C-52



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

STAGE-FREQUENCY
BELLE RIVER AT
PIERRE PASS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-53

PLATE C-53

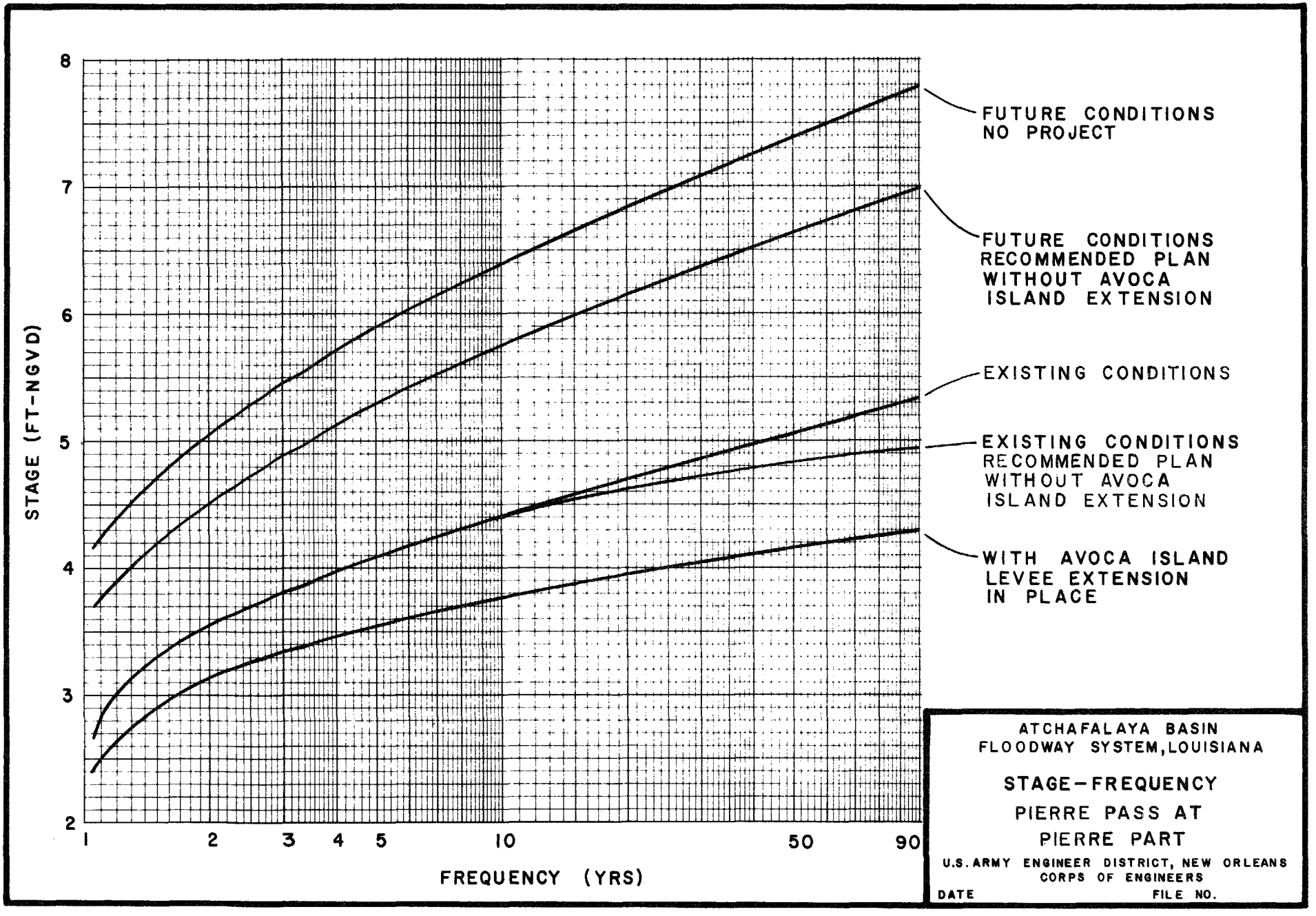


PLATE C-54

PLATE C-54

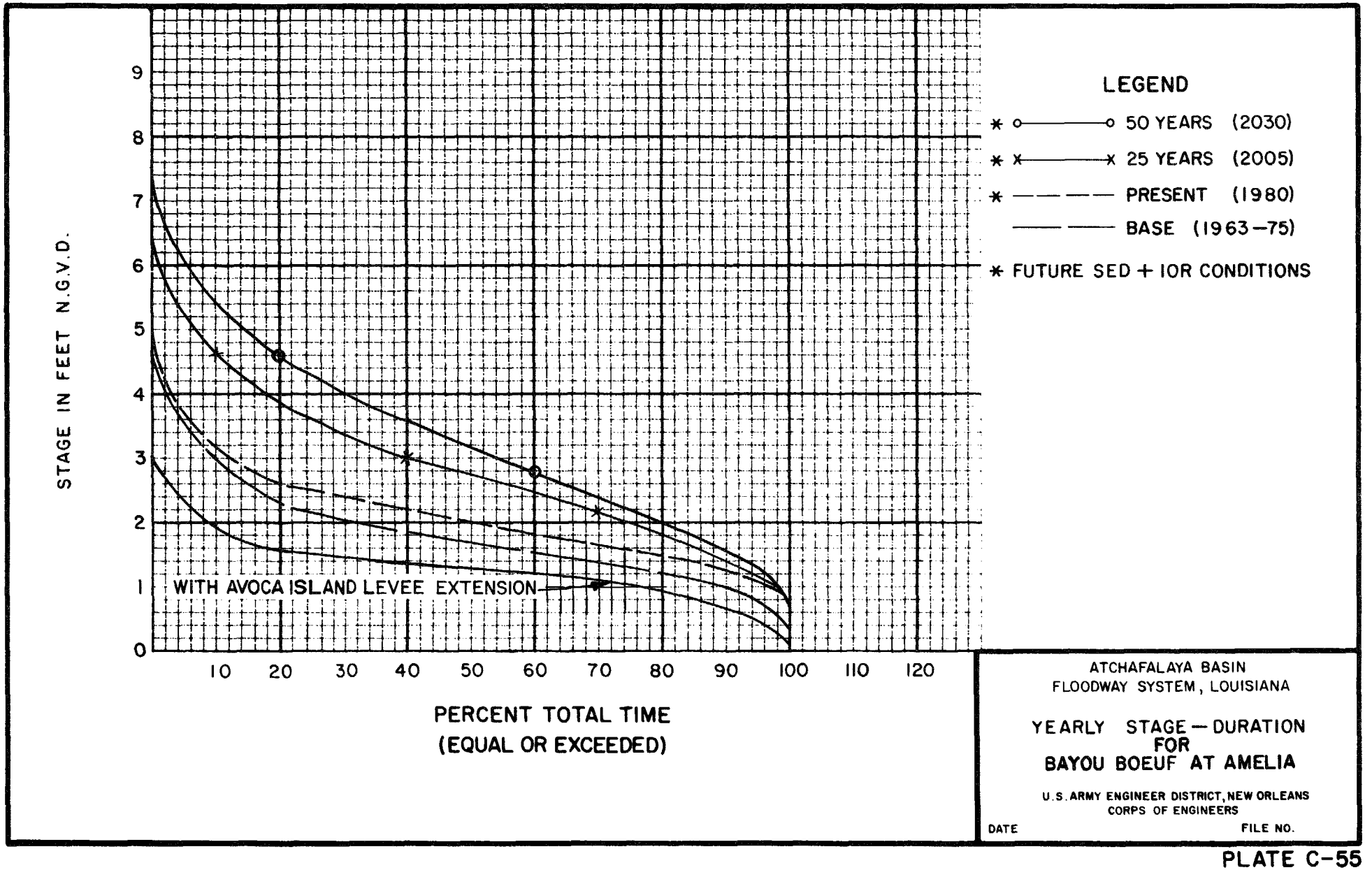

STAGE IN FEET N.G.V.D.
9
8
7
6
5
4
3
2
1
0
10
20
30
40
50
60
70
80
90
100
110
120
PERCENT TOTAL TIME
(EQUAL OR EXCEEDED)
WITH AVOCA ISLAND LEVEE EXTENSION
LEGEND
50 YEARS (2030)
25 YEARS (2005)
PRESENT (1980)
BASE (1963–75)
FUTURE SED + IOR CONDITIONS
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
YEARLY STAGE – DURATION
FOR
BAYOU BOEUF AT AMELIA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-55

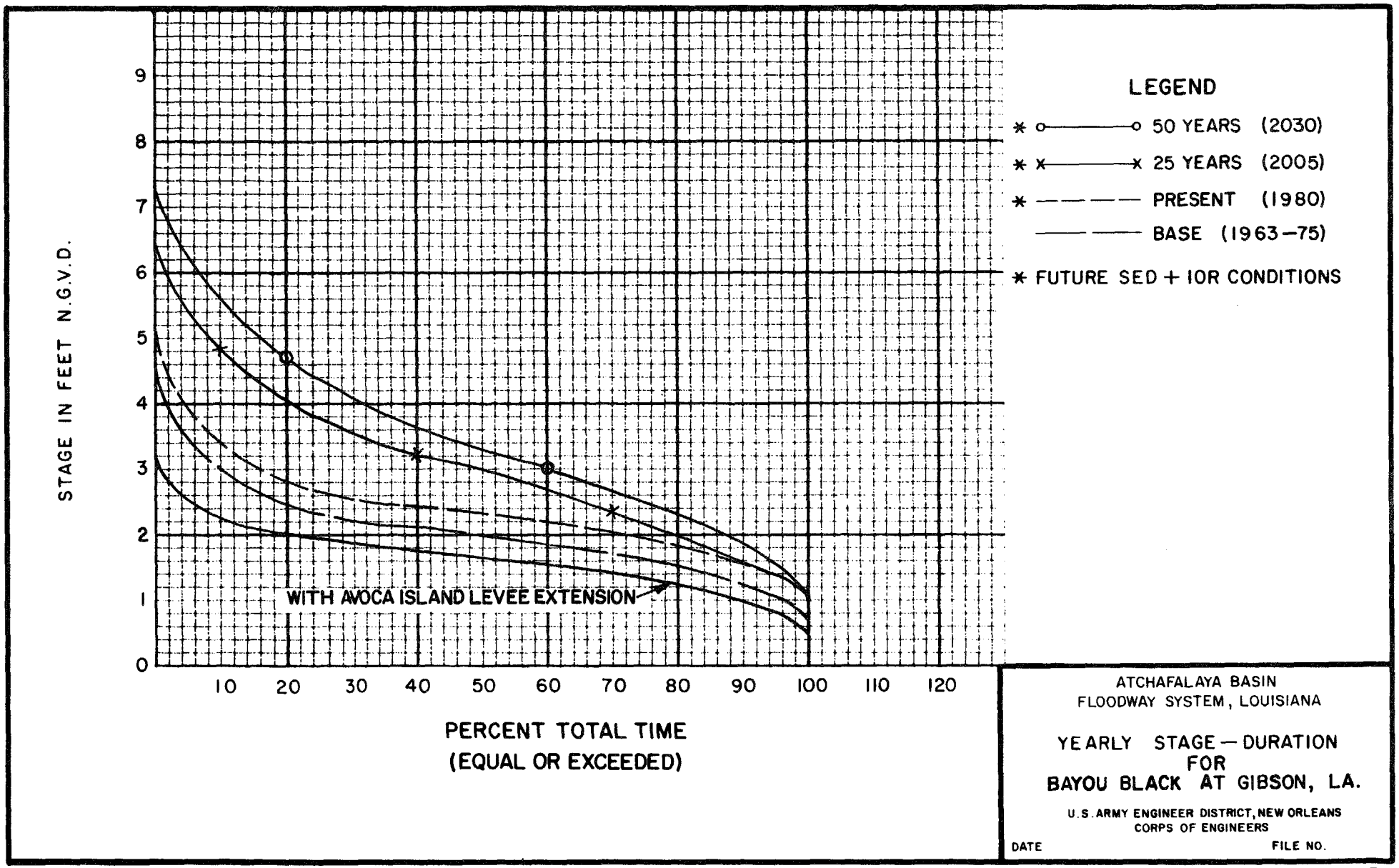
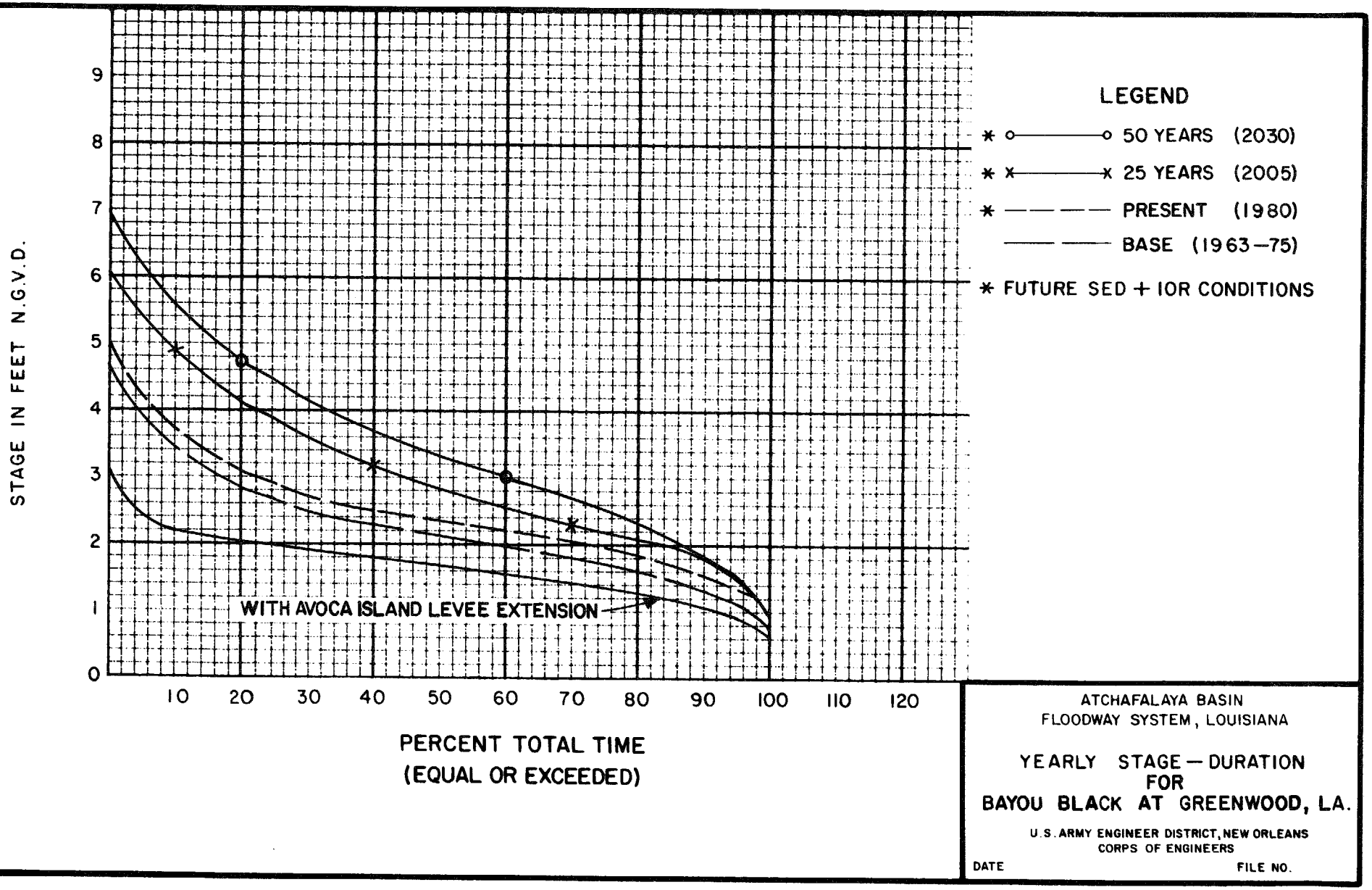

STAGE IN FEET N.G.V.D.
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
110
120
PERCENT TOTAL TIME
(EQUAL OR EXCEEDED)
WITH AVOCA ISLAND LEVEE EXTENSION
LEGEND
50 YEARS (2030)
25 YEARS (2005)
PRESENT (1980)
BASE (1963–75)
FUTURE SED + IOR CONDITIONS
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
YEARLY STAGE – DURATION
FOR
BAYOU BLACK AT GIBSON, LA.
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-56



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

YEARLY STAGE – DURATION
FOR
BAYOU BLACK AT GREENWOOD, LA.

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-57

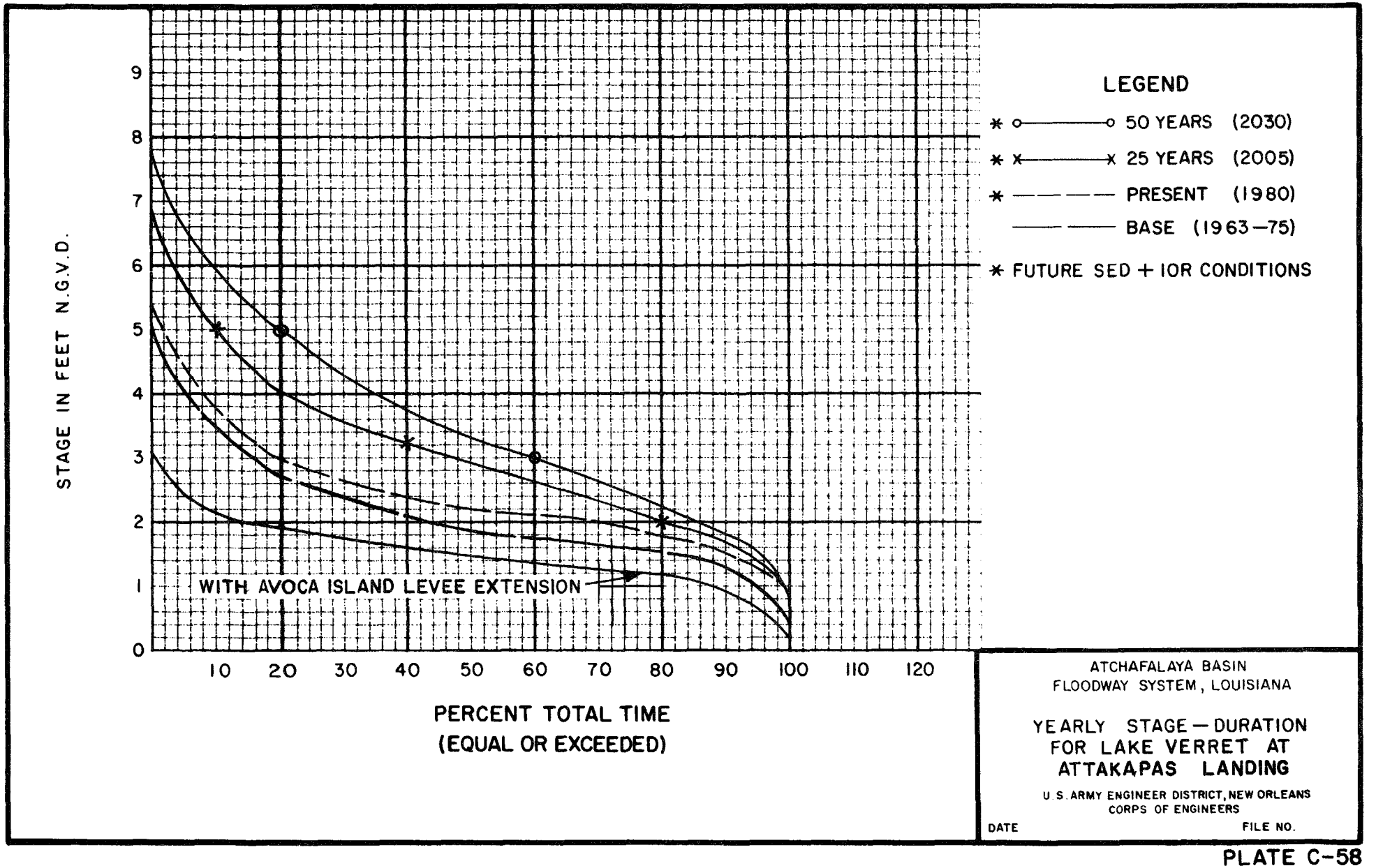

STAGE IN FEET N.G.V.D.
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
110
120
PERCENT TOTAL TIME
(EQUAL OR EXCEEDED)
WITH AVOCA ISLAND LEVEE EXTENSION
LEGEND
50 YEARS (2030)
25 YEARS (2005)
PRESENT (1980)
BASE (1963–75)
FUTURE SED + IOR CONDITIONS
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
YEARLY STAGE – DURATION
FOR LAKE VERRET AT
ATTAKAPAS LANDING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-58

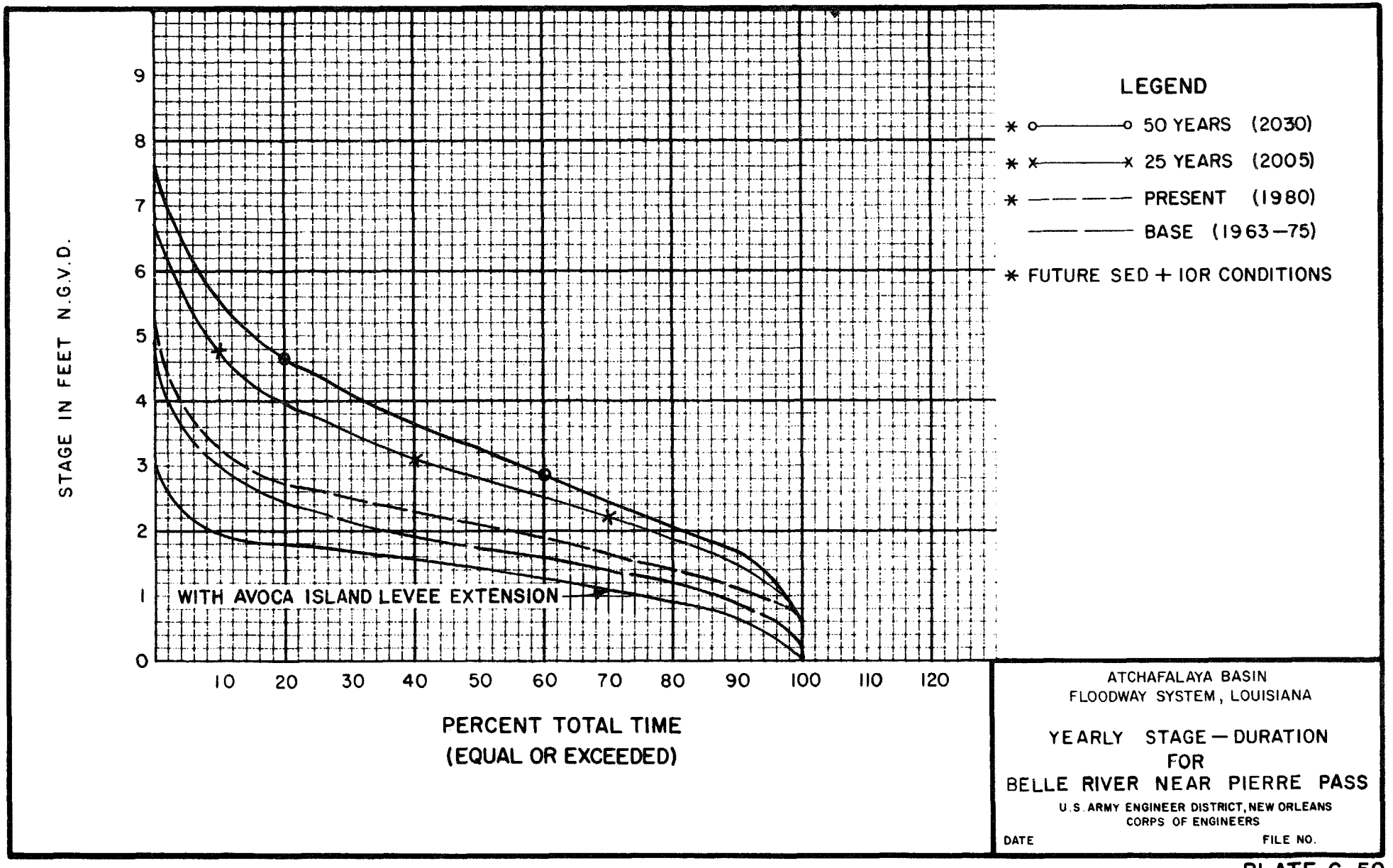

STAGE IN FEET N.G.V.D.
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
110
120
PERCENT TOTAL TIME
(EQUAL OR EXCEEDED)
WITH AVOCA ISLAND LEVEE EXTENSION
LEGEND
50 YEARS (2030)
25 YEARS (2005)
PRESENT (1980)
BASE (1963–75)
FUTURE SED + IOR CONDITIONS
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
YEARLY STAGE – DURATION
FOR
BELLE RIVER NEAR PIERRE PASS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-59

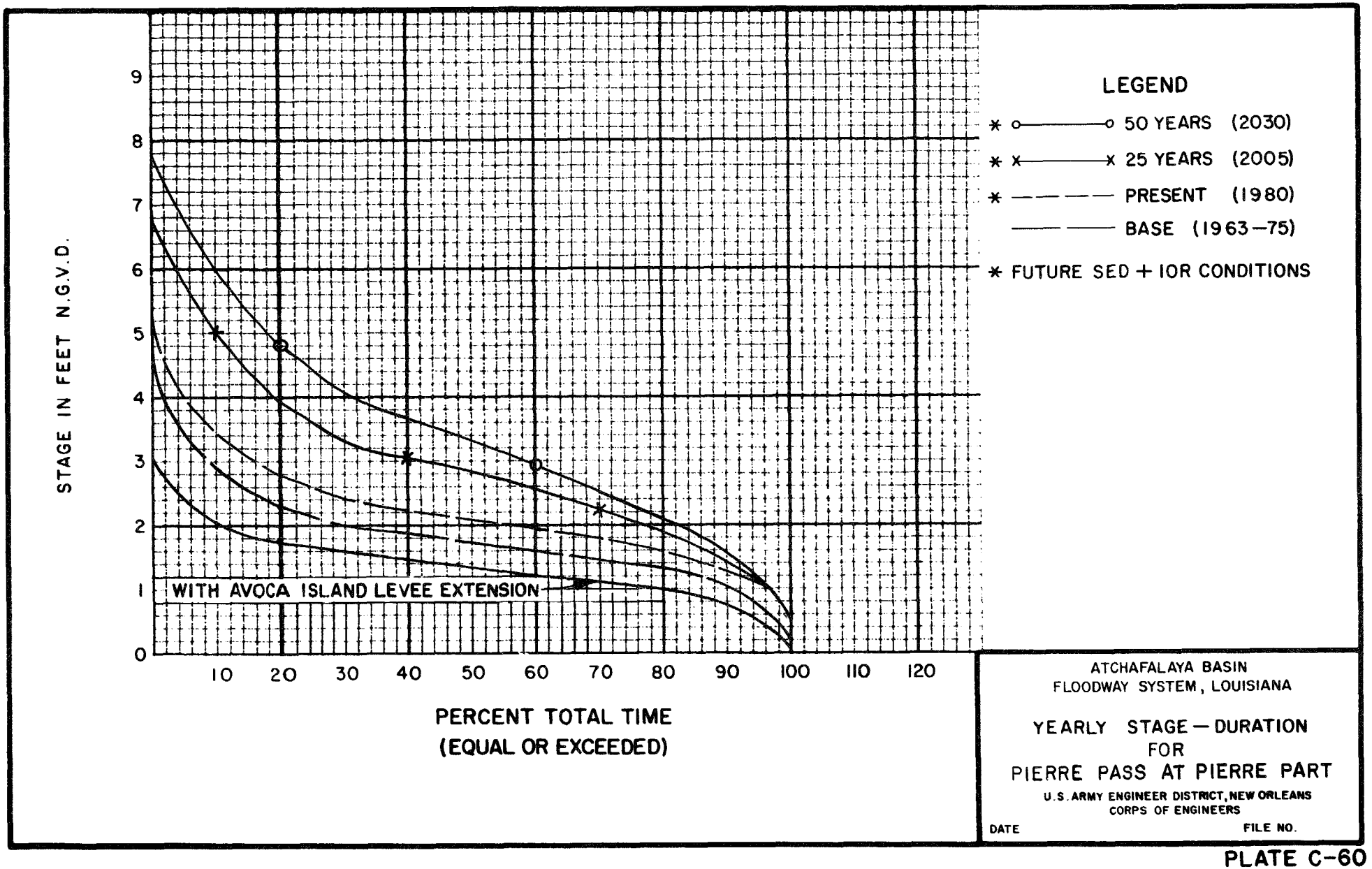
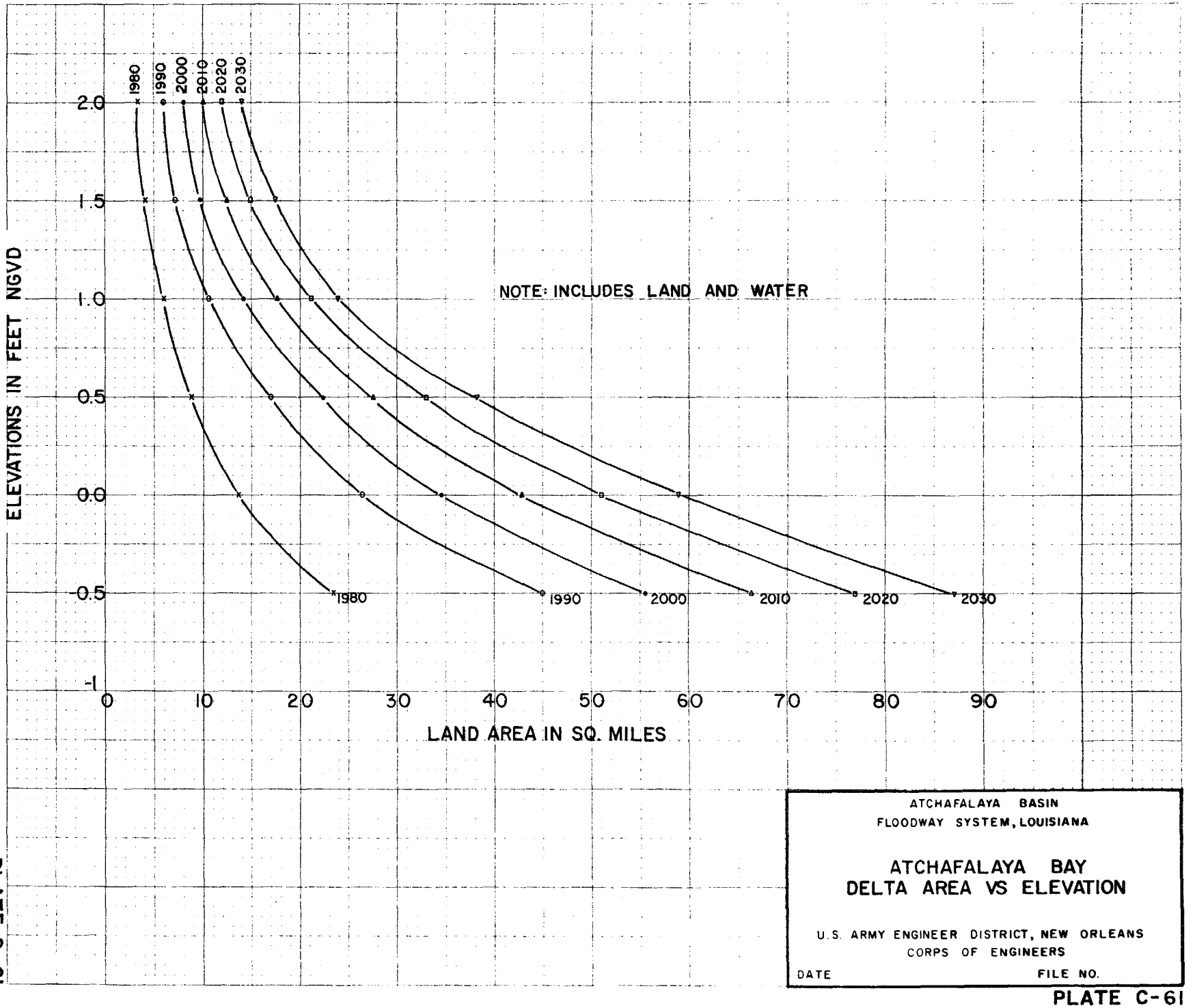

STAGE IN FEET N.G.V.D.
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
110
120
PERCENT TOTAL TIME
(EQUAL OR EXCEEDED)
WITH AVOCA ISLAND LEVEE EXTENSION
LEGEND
50 YEARS (2030)
25 YEARS (2005)
PRESENT (1980)
BASE (1963–75)
FUTURE SED + IOR CONDITIONS
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
YEARLY STAGE — DURATION
FOR
PIERRE PASS AT PIERRE PART
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-60



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY
DELTA AREA VS ELEVATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-61

PLATE C-61

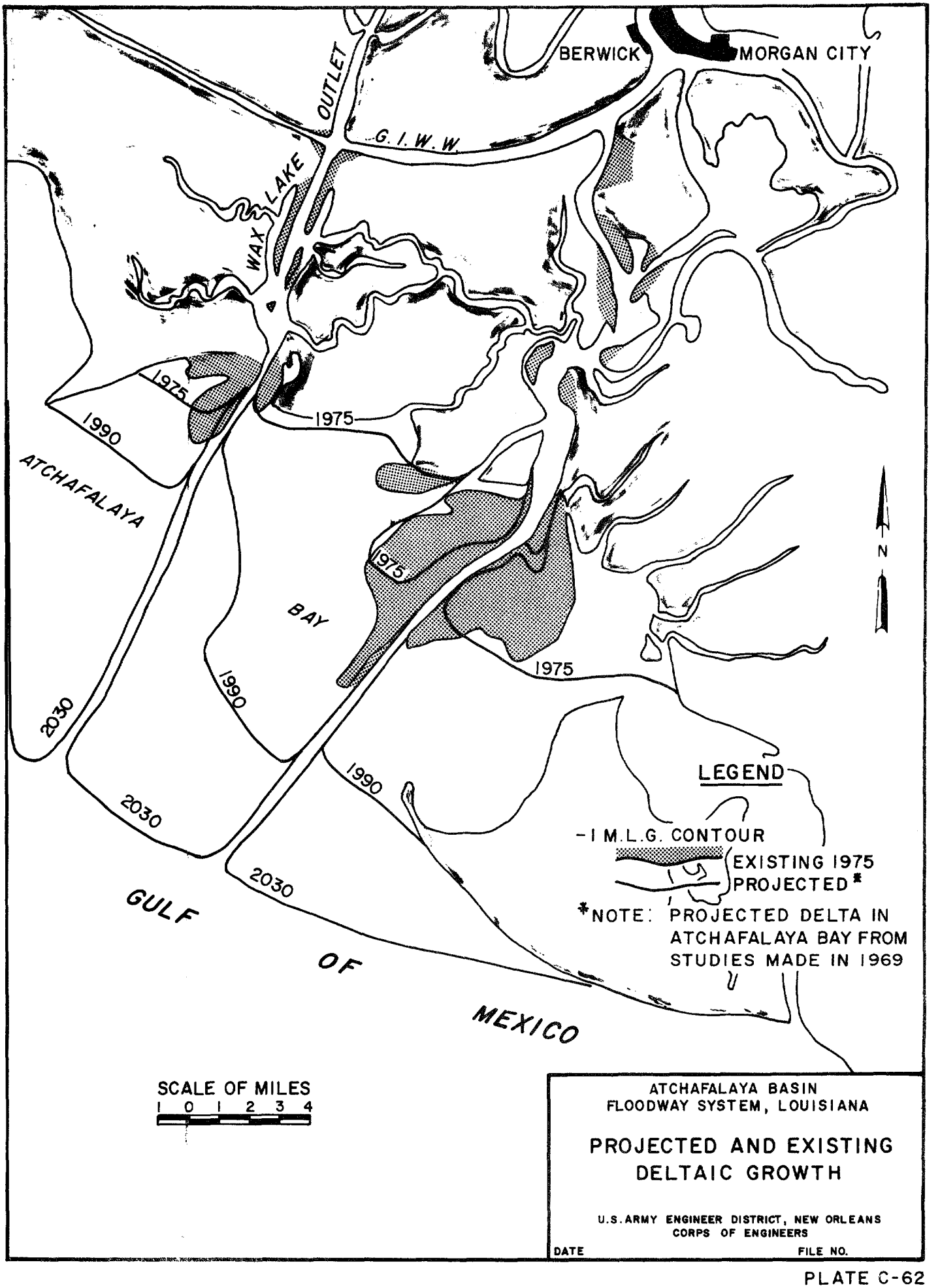
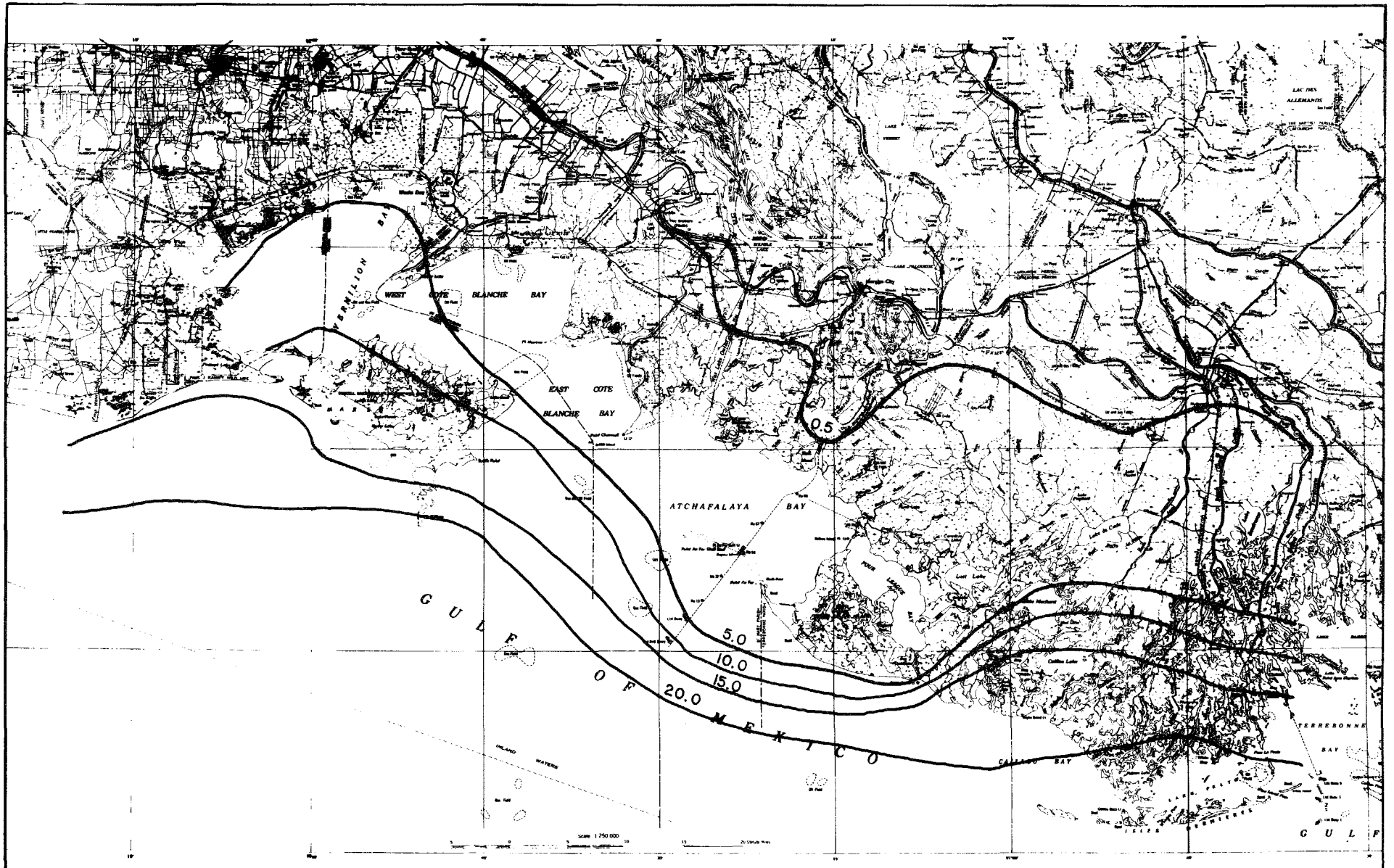

BERWICK
MORGAN CITY
OUTLET
G. I. W. W.
WAX LAKE
1975
1990
ATCHAFALAYA
BAY
1975
1975
1990
2030
1990
2030
2030
GULF
OF
MEXICO
N
LEGEND
1 M.L.G. CONTOUR
EXISTING 1975
PROJECTED *
*NOTE: PROJECTED DELTA IN ATCHAFALAYA BAY FROM STUDIES MADE IN 1969
SCALE OF MILES
1 0 1 2 3 4
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
PROJECTED AND EXISTING
DELTAIC GROWTH
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

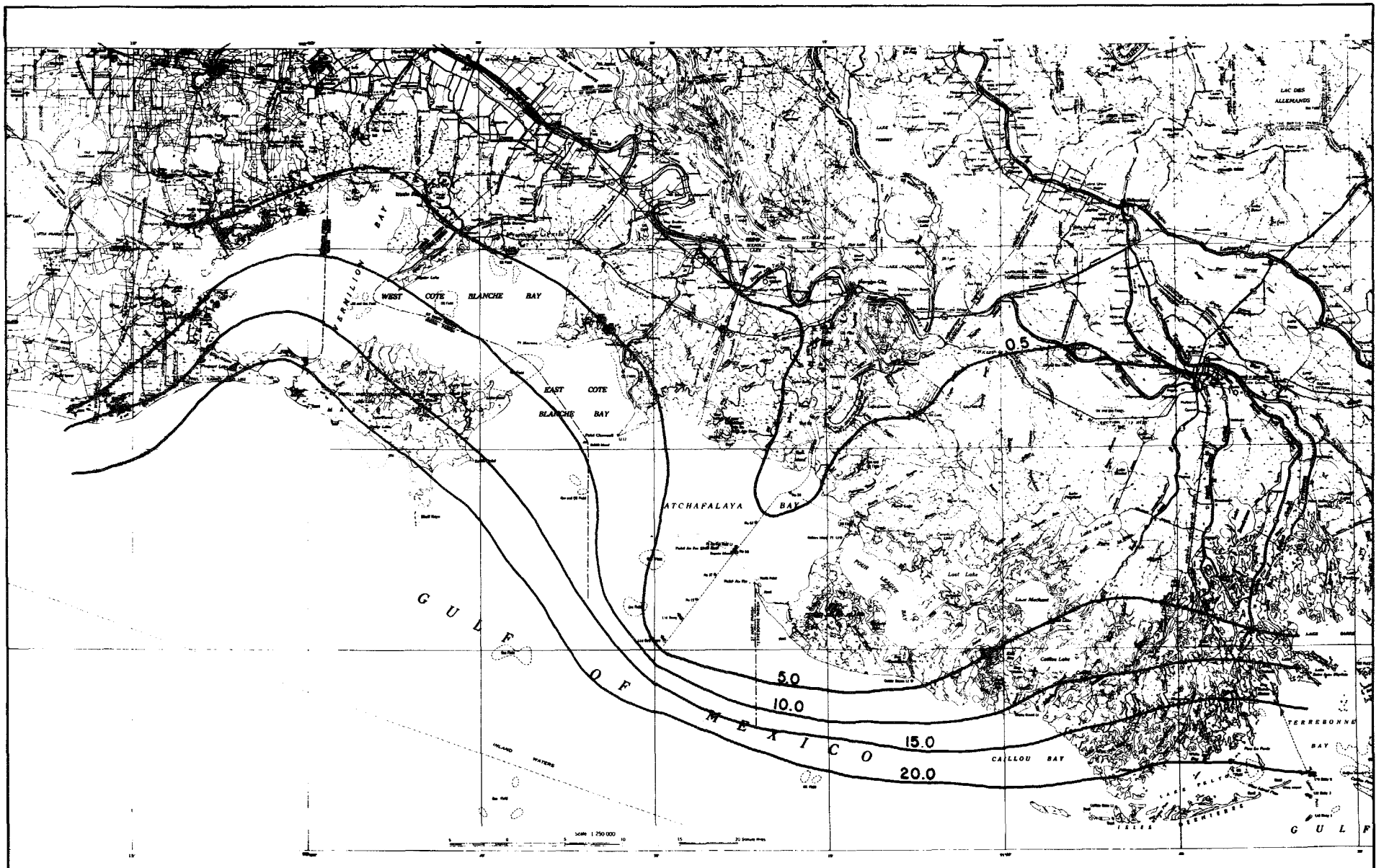
PLATE C-62



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BAY ISOHALINES
PRESENT 90,000 CFS 70/30
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE C-63

PLATE C-63



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

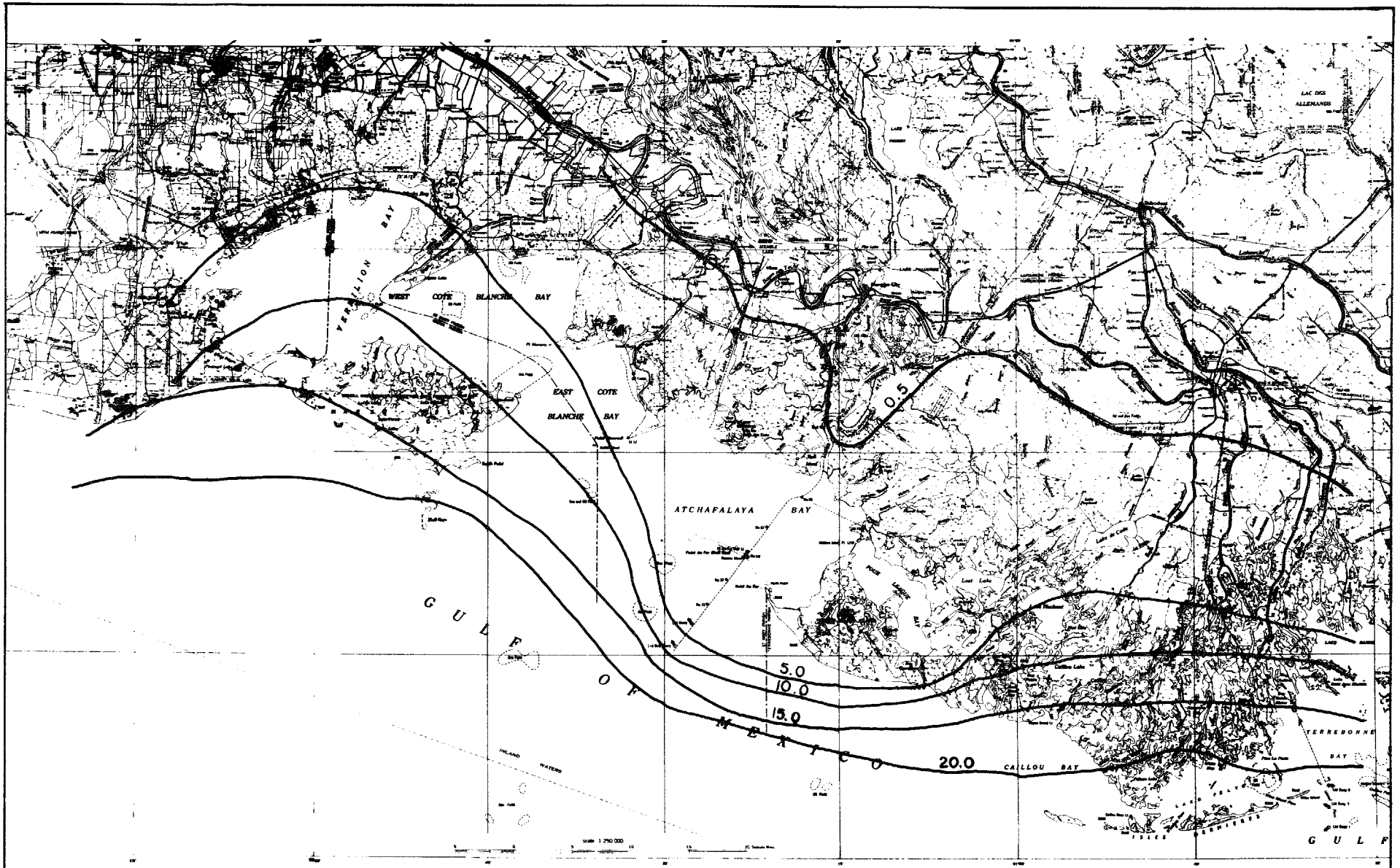
ATCHAFALAYA BAY ISOHALINES
PRESENT 90,000 CFS 100/0

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-64

PLATE C-64



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES

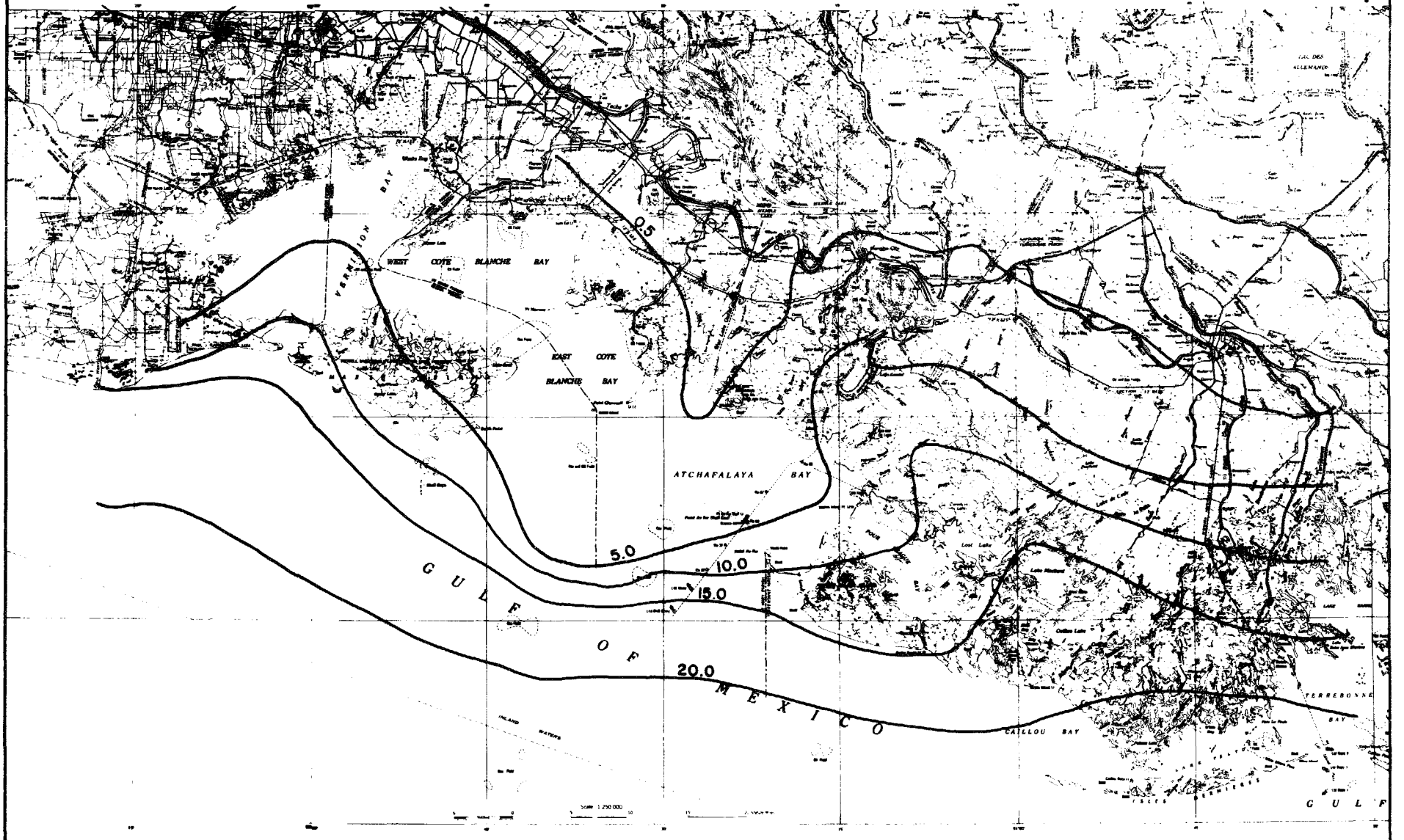
PRESENT 90,000 CFS 80/20

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-65

PLATE C-65



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

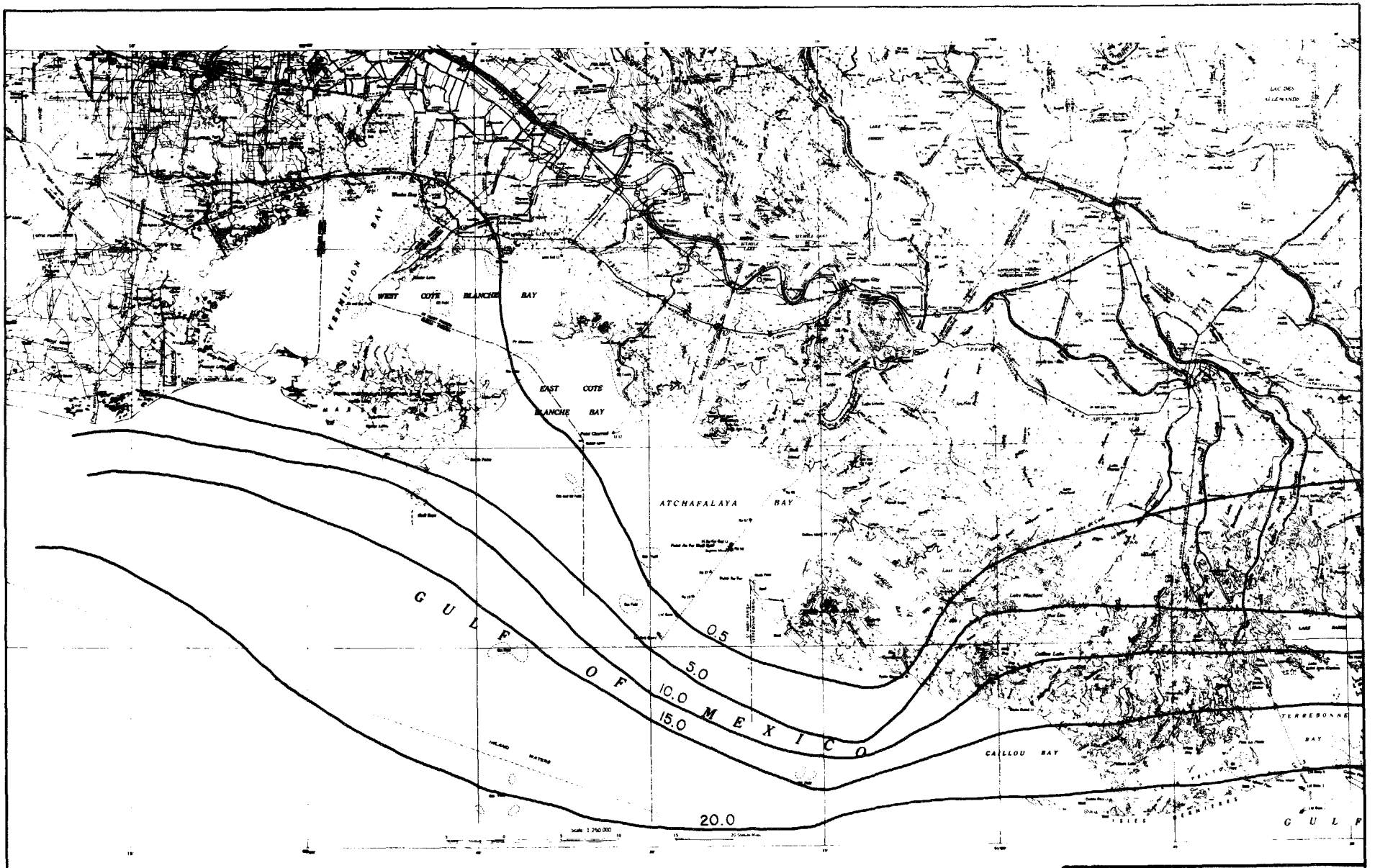
ATCHAFALAYA BAY ISOHALINES
PRESENT 90,000 CFS 0/100

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-66

PLATE C-66



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

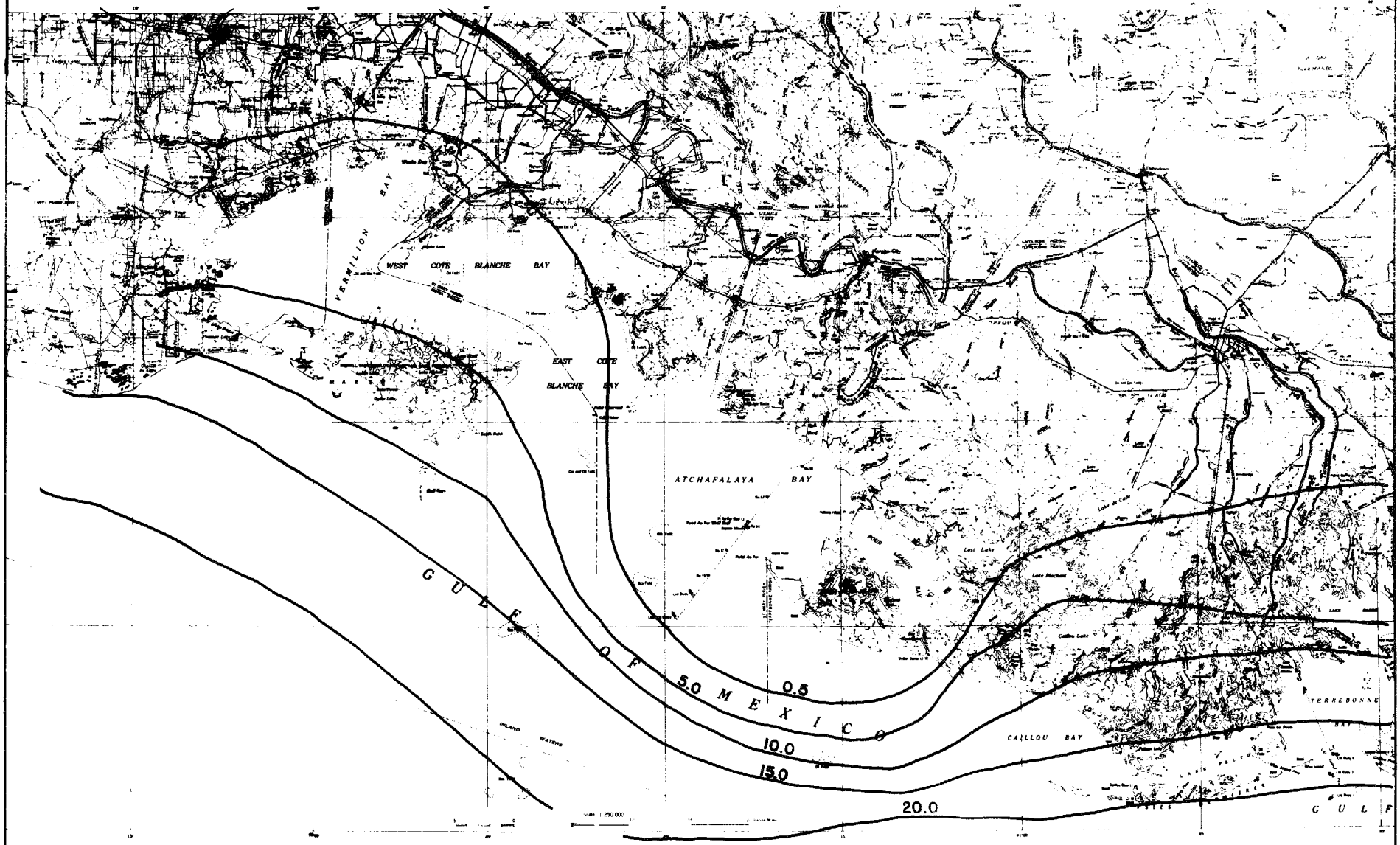
ATCHAFALAYA BAY ISOHALINES
PRESENT 320,000 CFS 70/30

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-67

PLATE-C-67



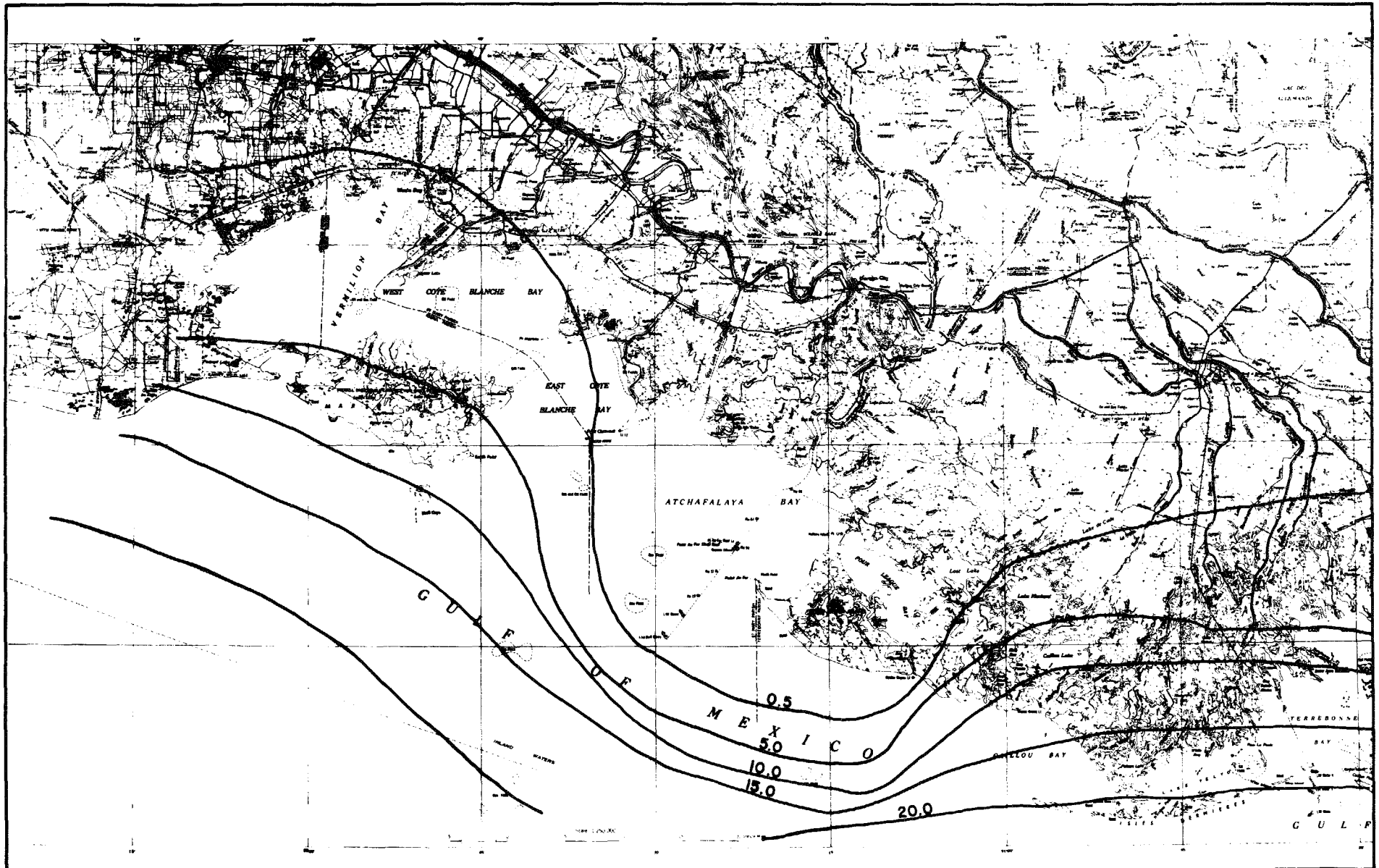
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
PRESENT 320,000 CFS 100/0

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE C-68

PLATE C-68



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FLOODWAY SYSTEM, LOUISIANA

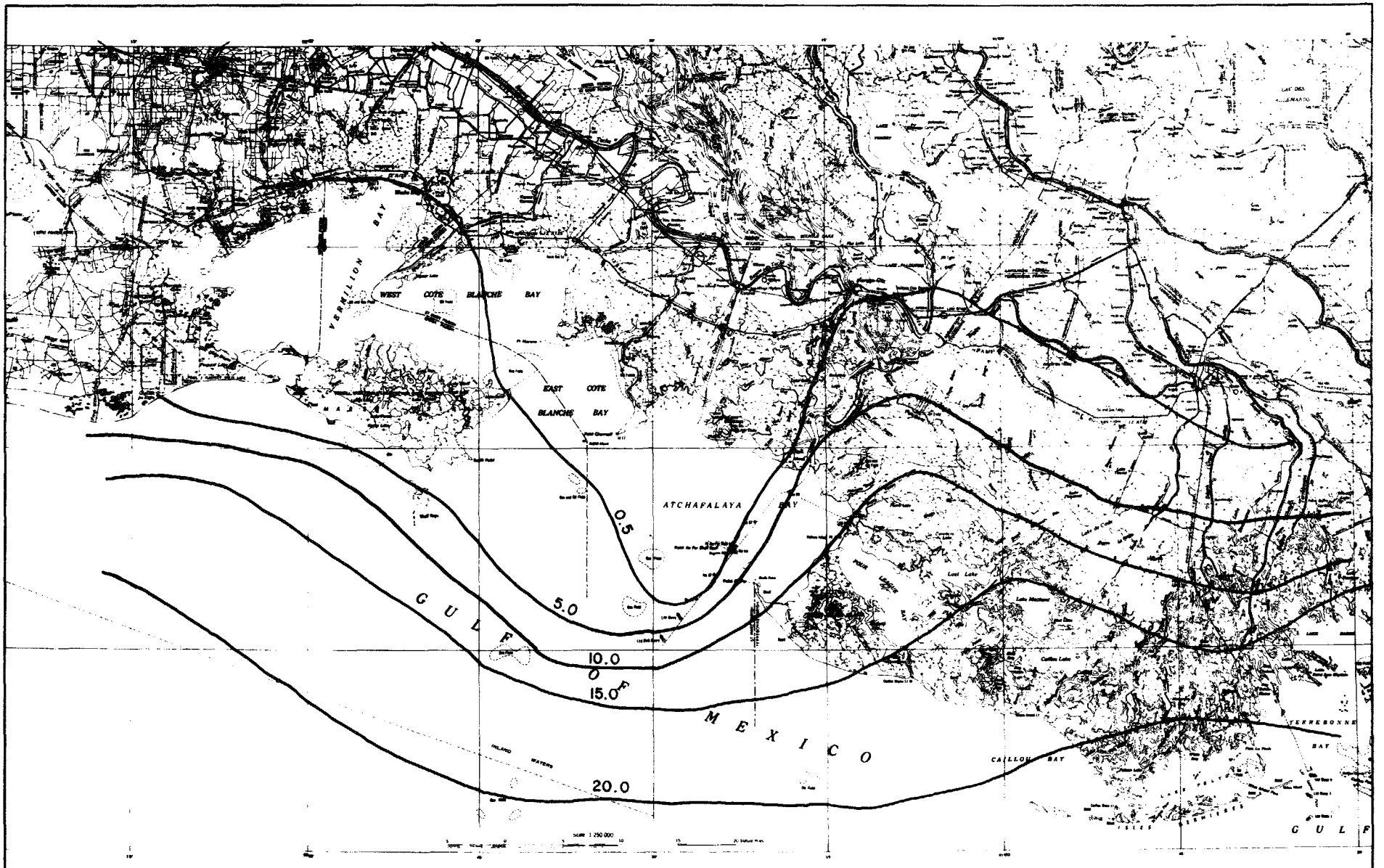
ATCHAFALAYA BAY ISOHALINES
PRESENT 320,000 CFS 80/20

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-69

PLATE C-69



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

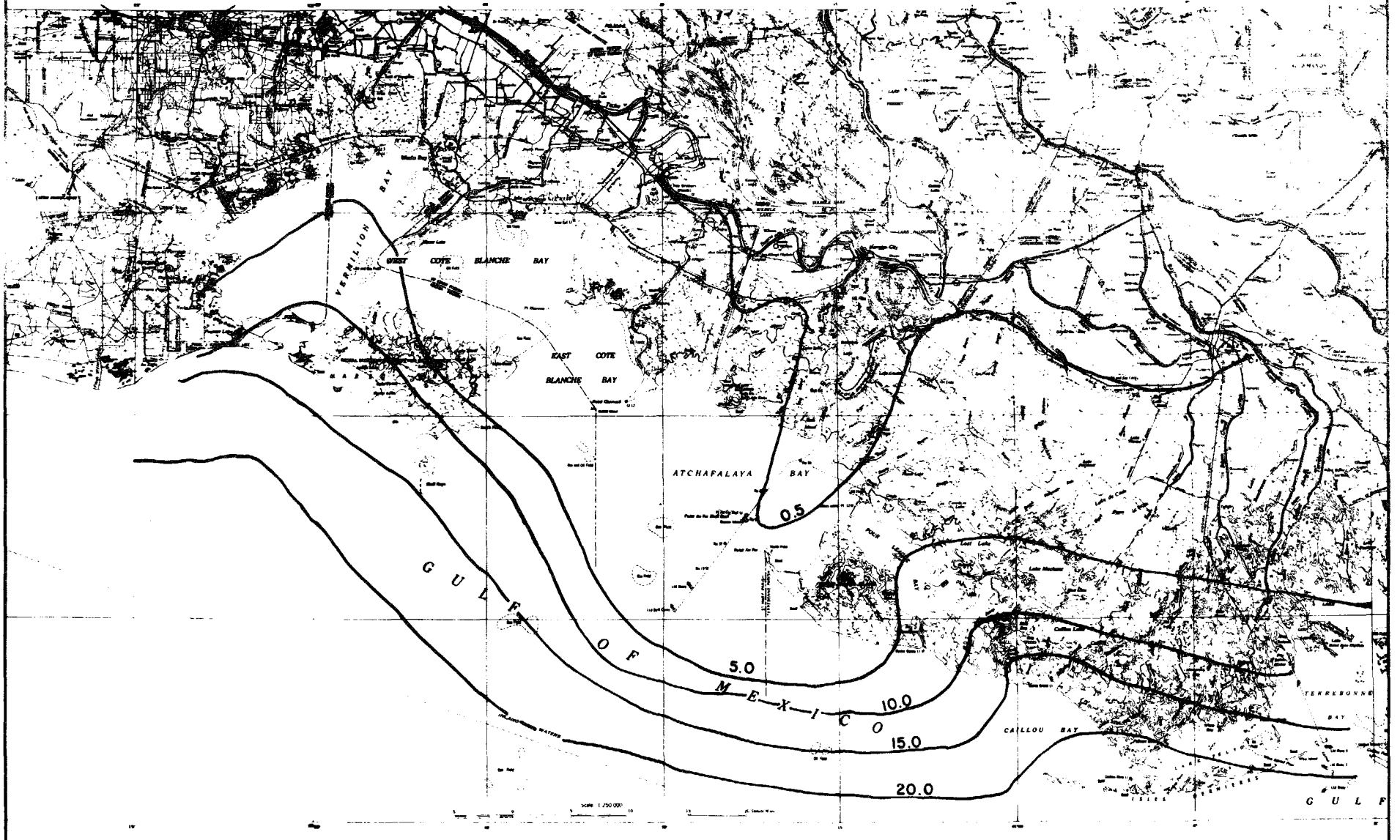
ATCHAFALAYA BAY ISOHALINES
PRESENT 320,000 CFS 0/100

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-70

PLATE C-70



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

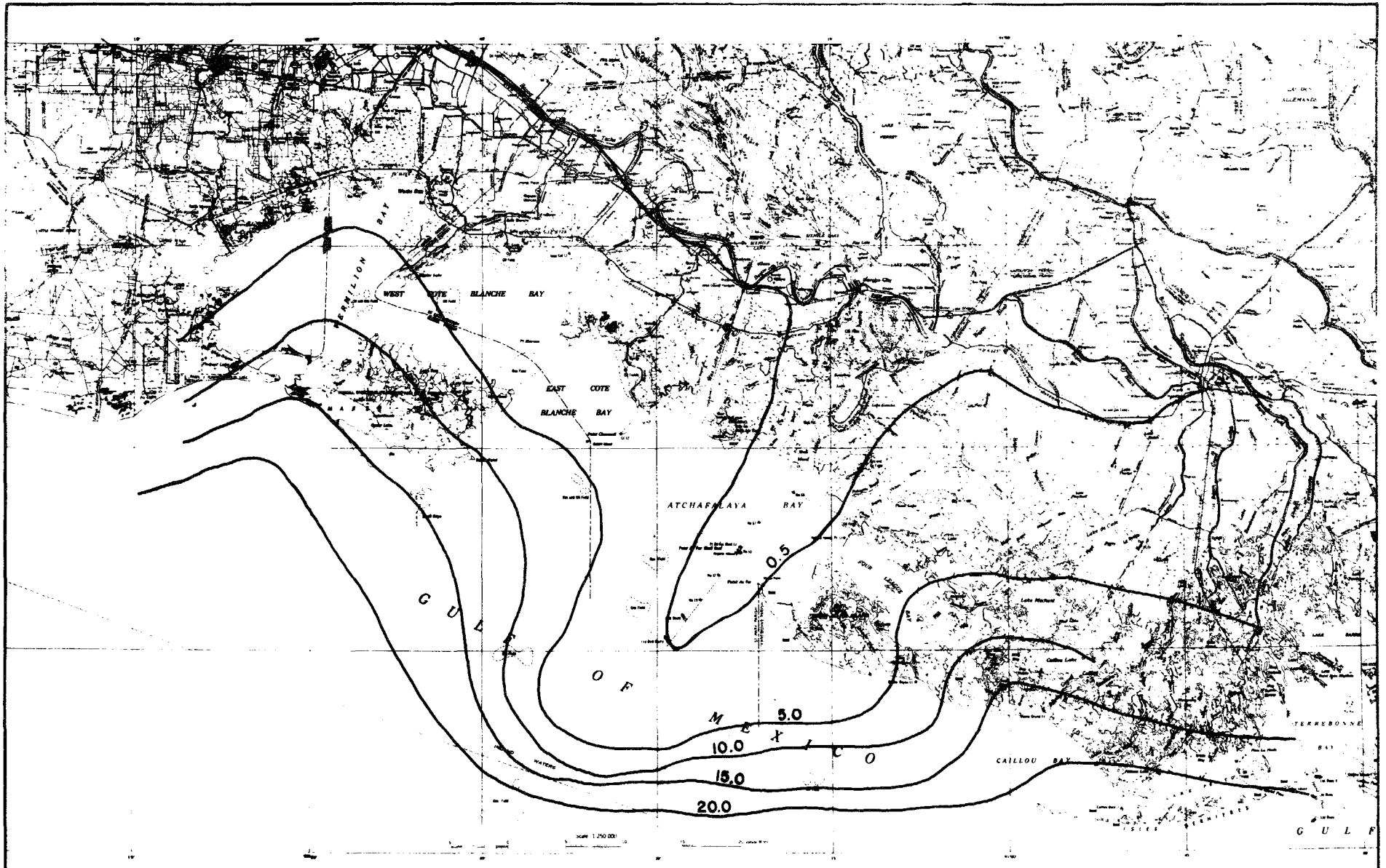
ATCHAFALAYA BAY ISOHALINES
FUTURE 90,000 CFS 70/30

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-71

PLATE C-71



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

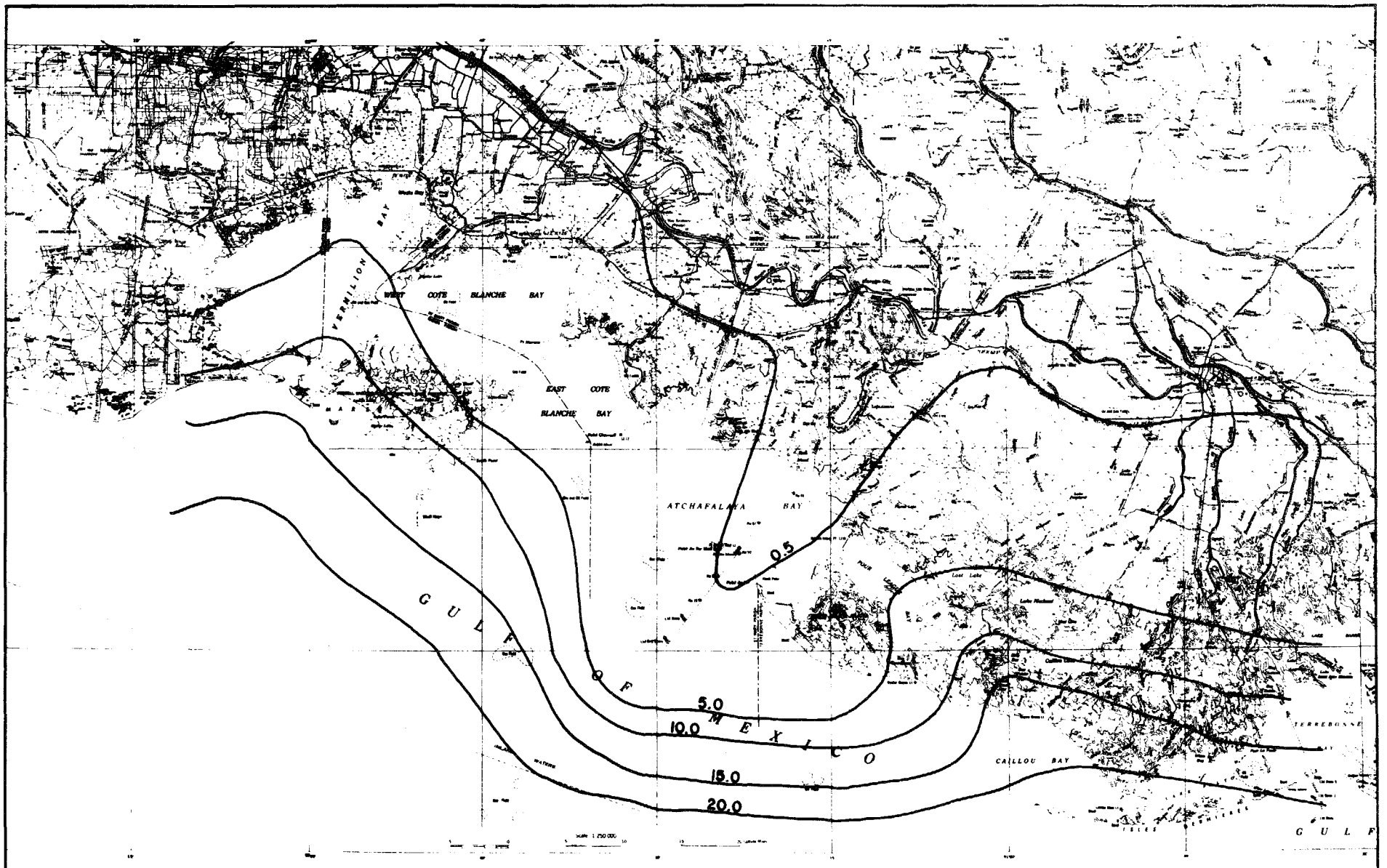
ATCHAFALAYA BAY ISOHALINES
FUTURE 90,000 CFS 100/0

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-72

PLATE C-72



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 90,000 CFS 80/20

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-73

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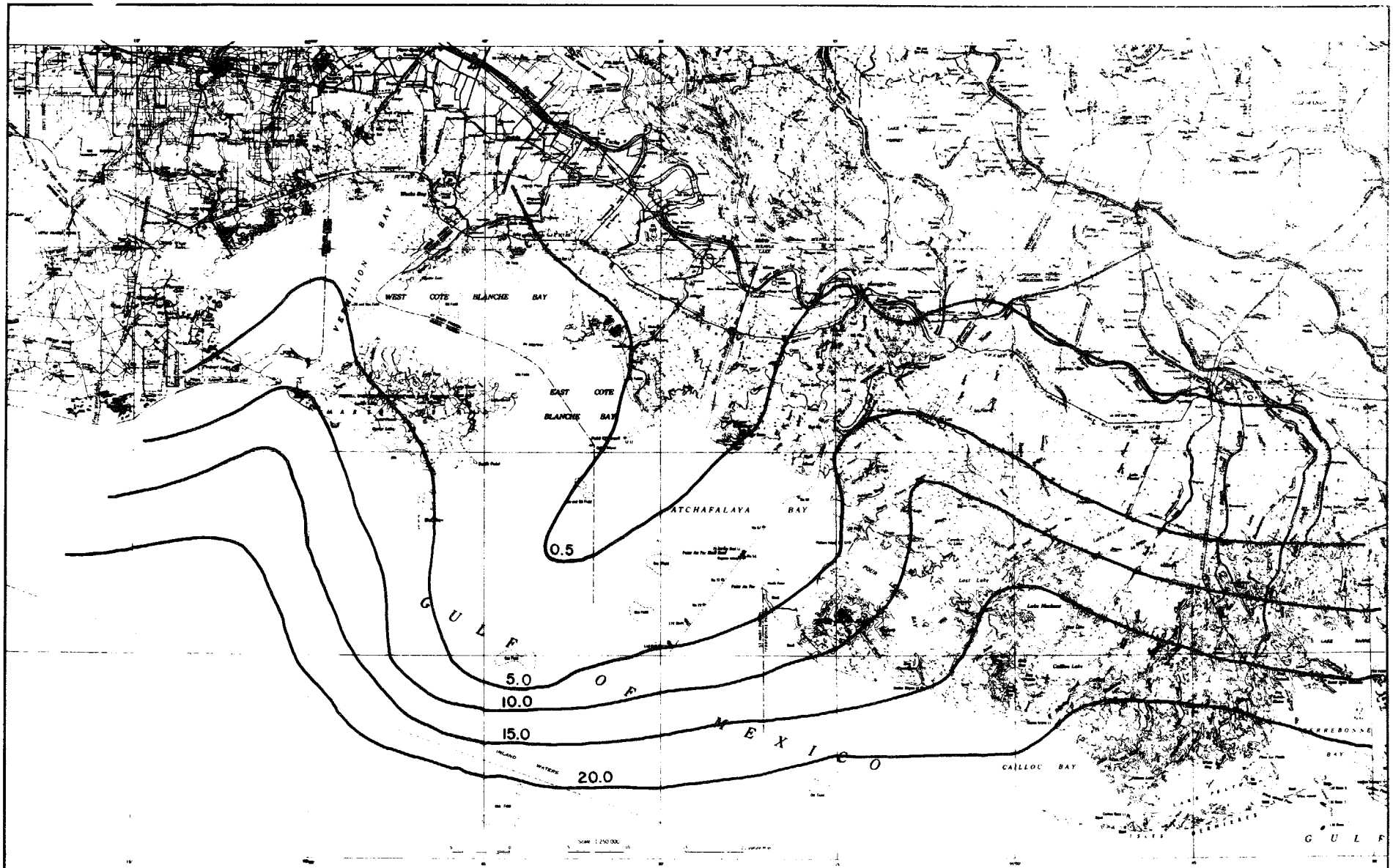

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES

FUTURE 90,000 CFS 0/100

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

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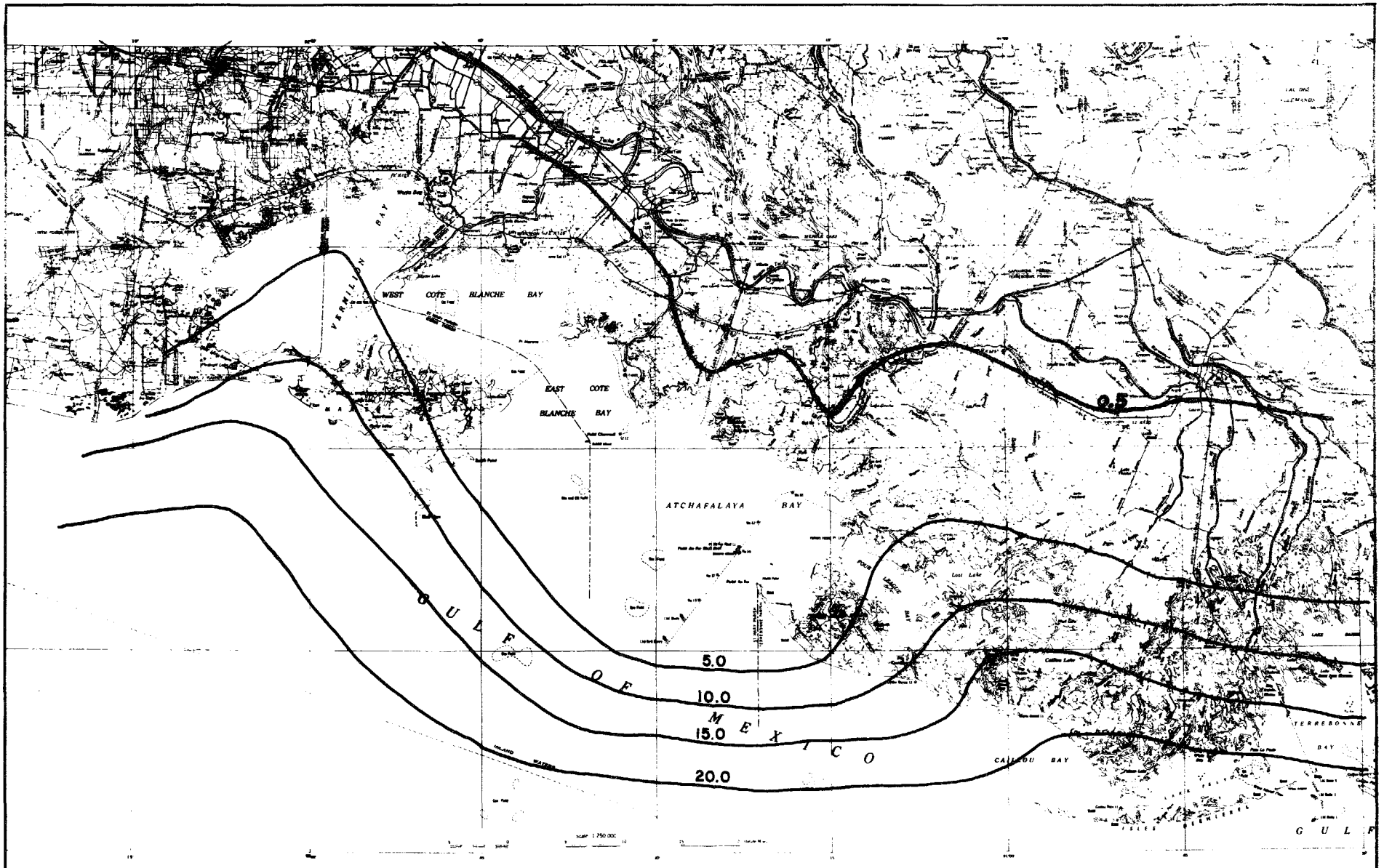
PLATE C-74



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 90,000 CFS FWO

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO

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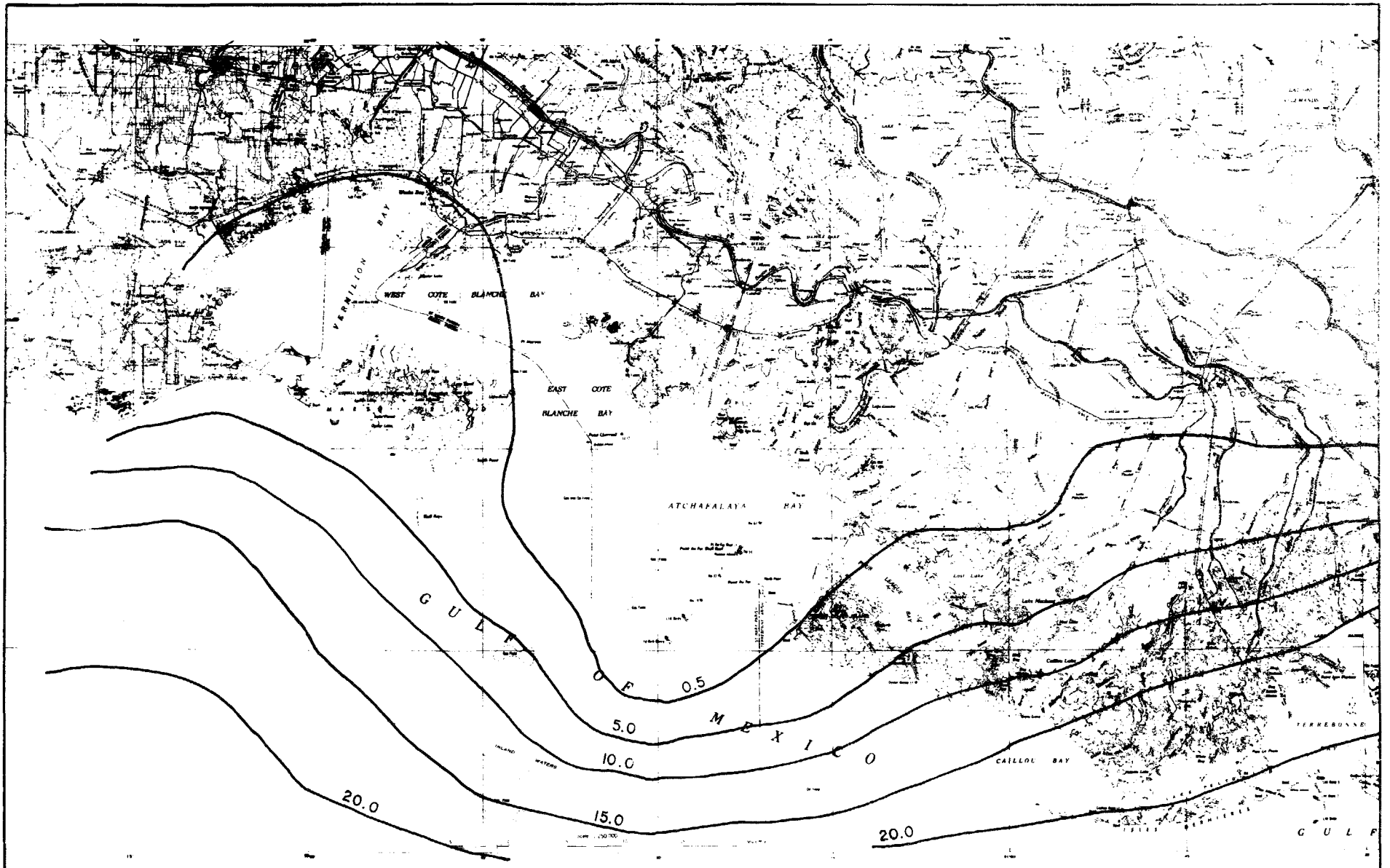
PLATE C-75



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

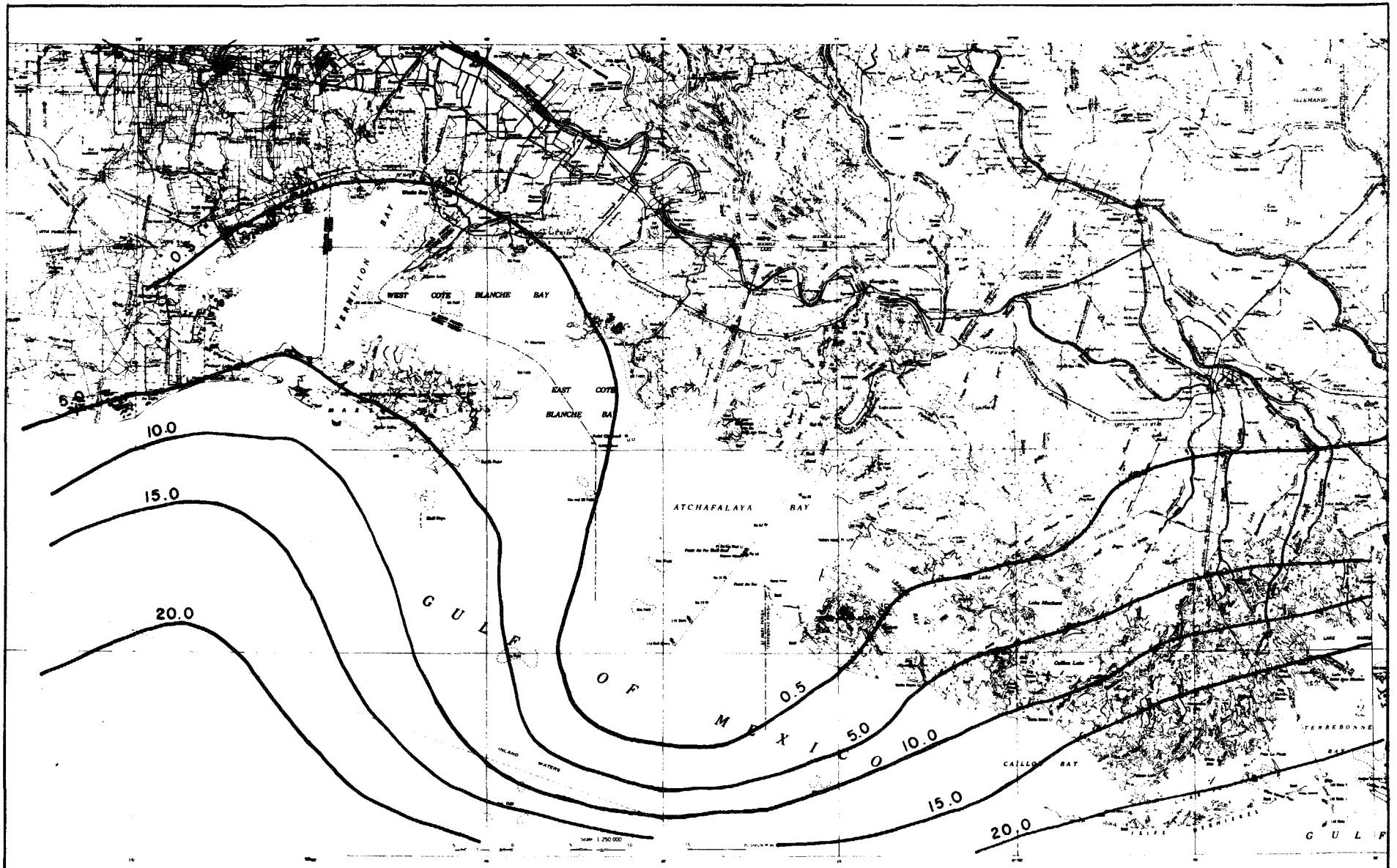
ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 70/30

U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-76

PLATE C-76



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

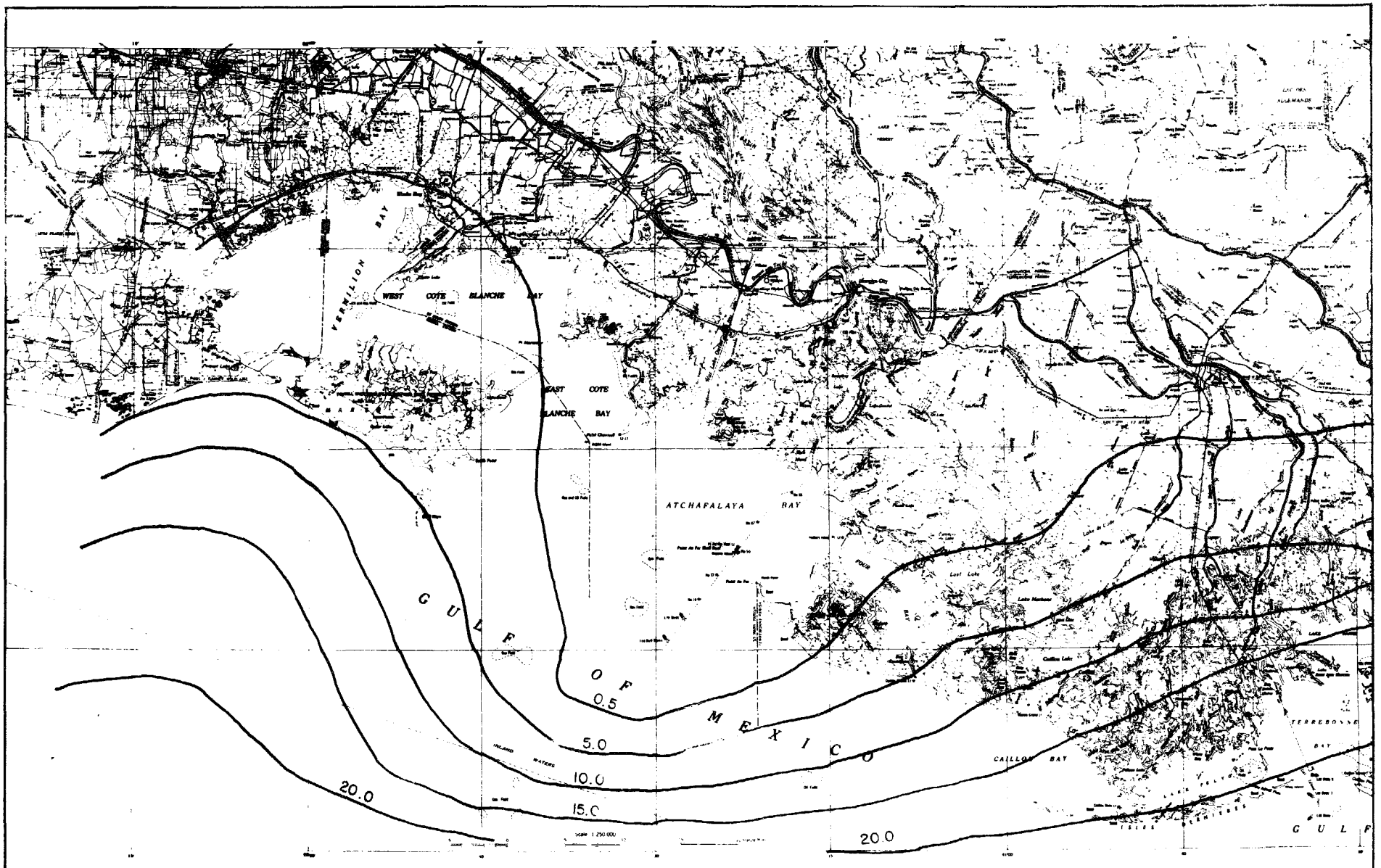
ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 100/0

U.S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-77

PLATE C-77



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

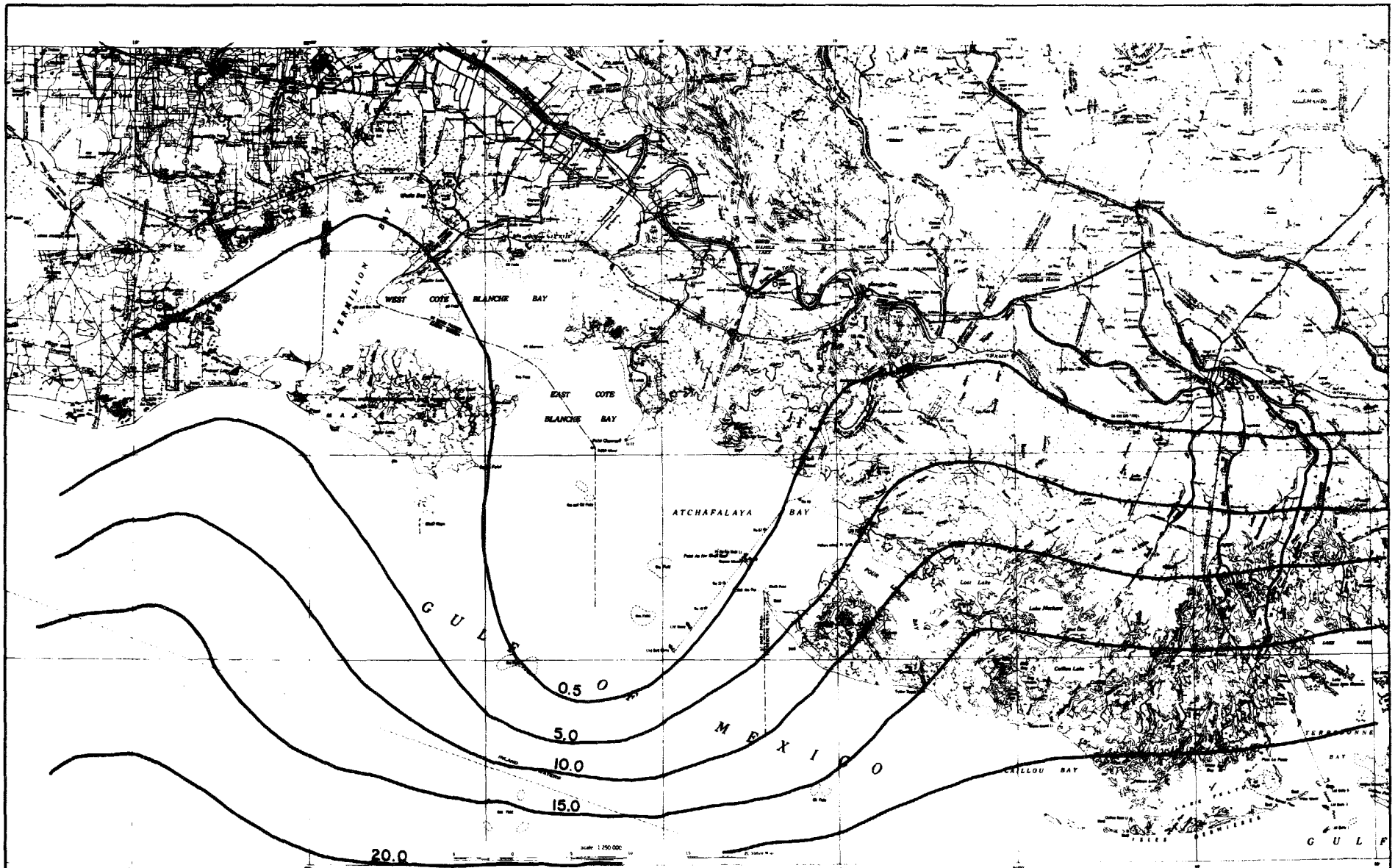
ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 80/20

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO

PLATE C-78

PLATE C-78



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

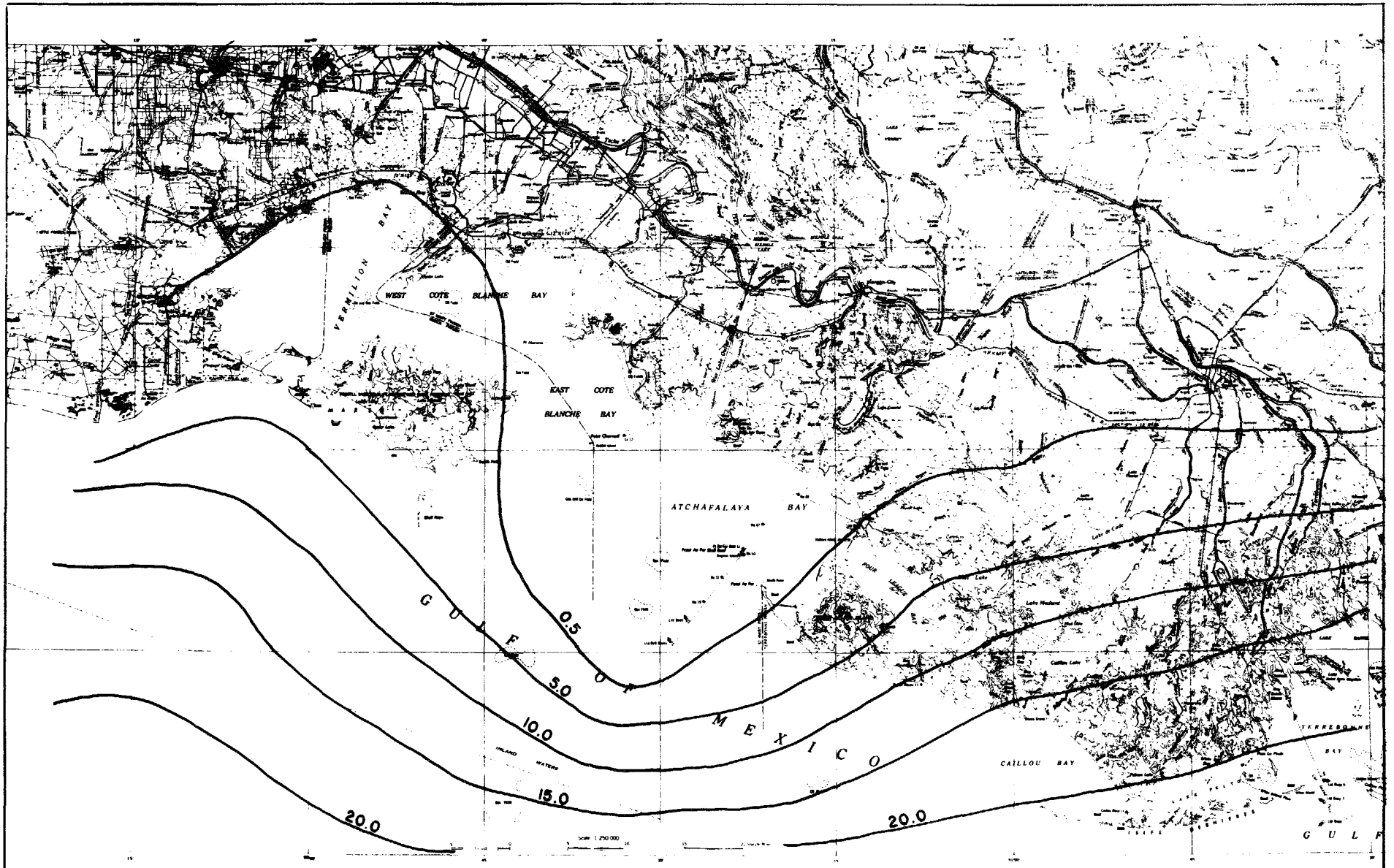
ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 0/100

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-79

PLATE C-79



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS FWO

U.S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-80

PLATE C-80

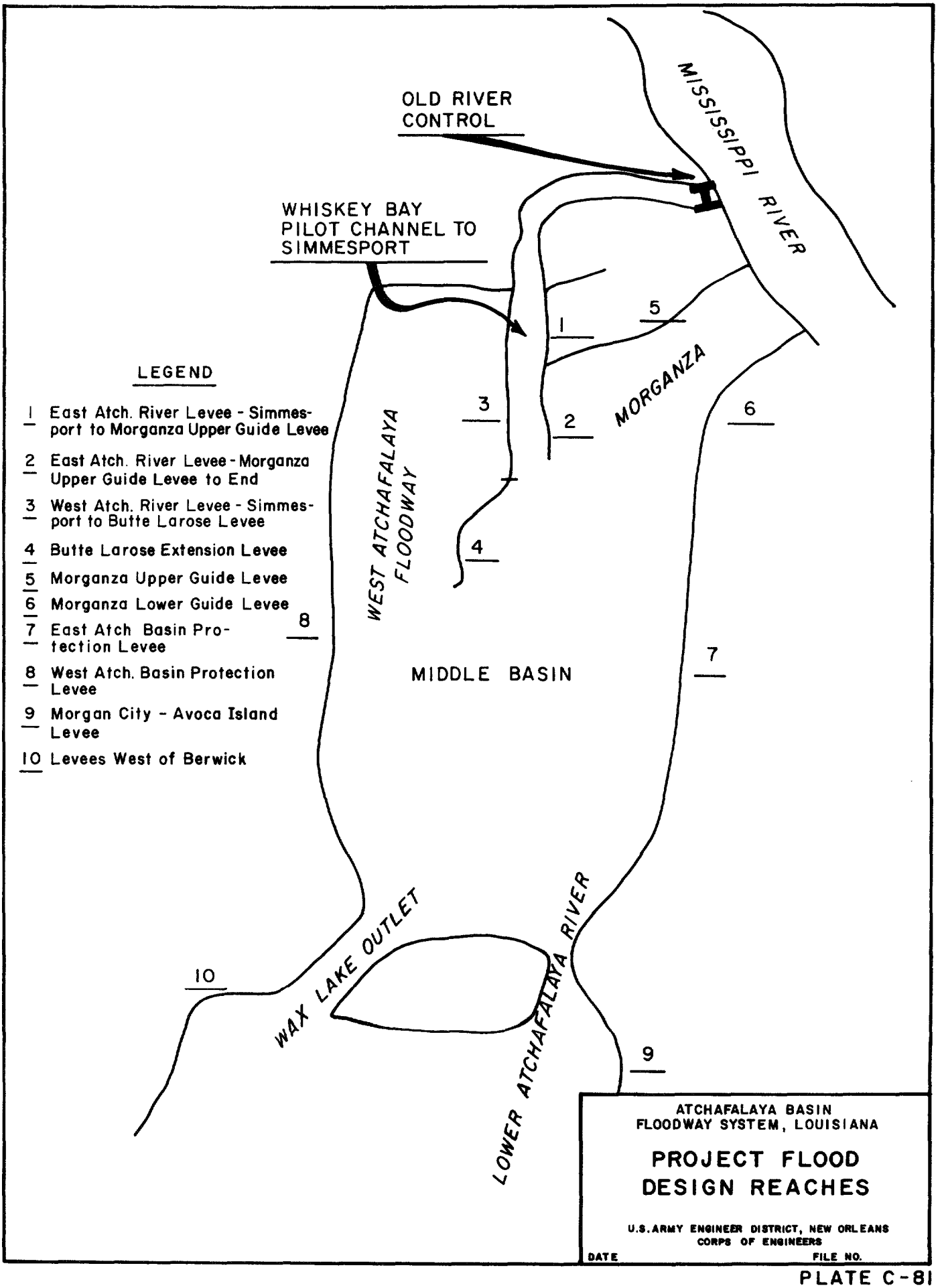
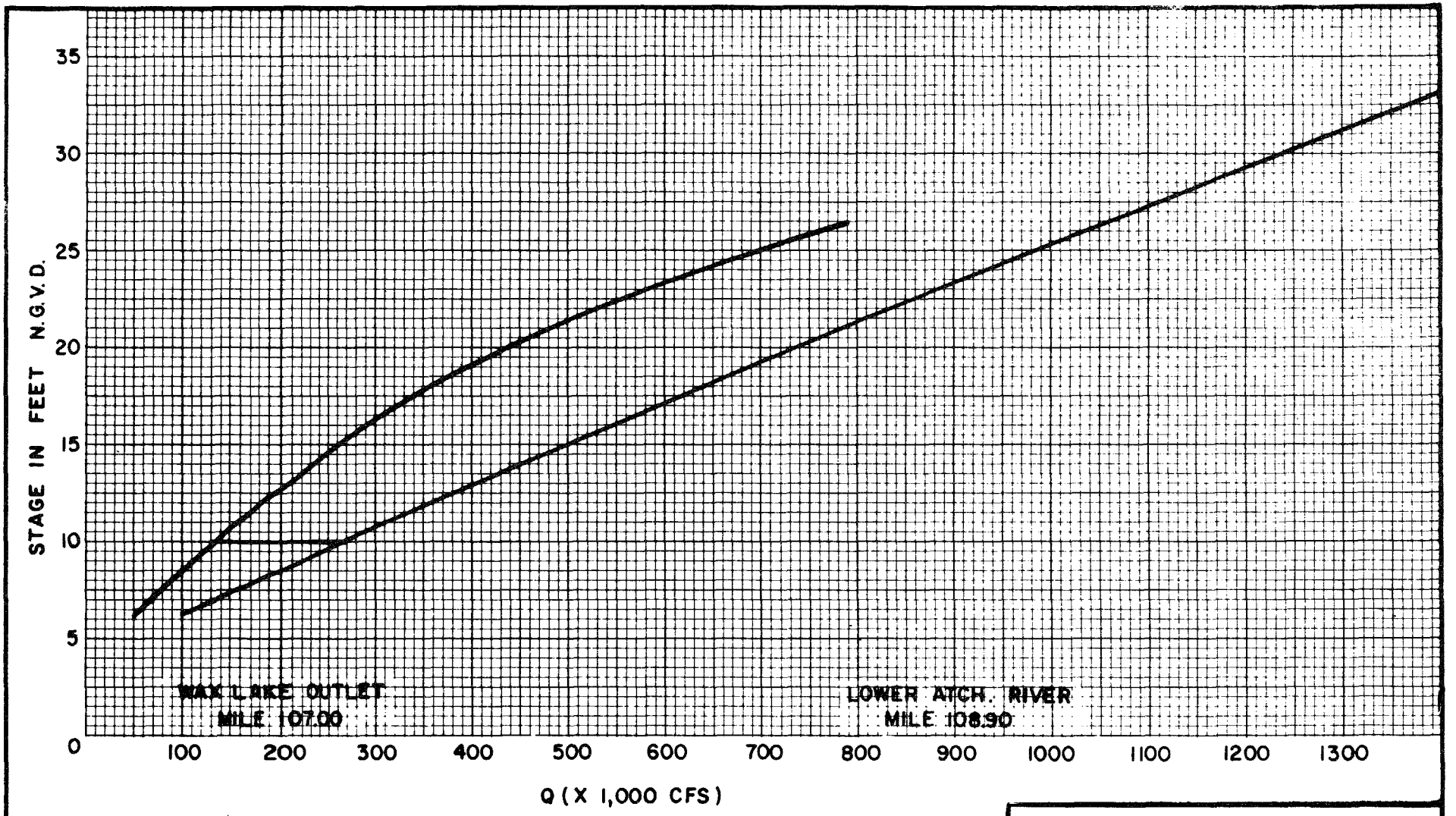

OLD RIVER CONTROL
MISSISSIPPI RIVER
WHISKEY BAY PILOT CHANNEL TO SIMMESPORT
LEGEND
1 East Atch. River Levee - Simmesport to Morganza Upper Guide Levee
2 East Atch. River Levee - Morganza Upper Guide Levee to End
3 West Atch. River Levee - Simmesport to Butte Larose Levee
4 Butte Larose Extension Levee
5 Morganza Upper Guide Levee
6 Morganza Lower Guide Levee
7 East Atch Basin Protection Levee
8 West Atch. Basin Protection Levee
9 Morgan City - Avoca Island Levee
10 Levees West of Berwick
1
2
3
4
5
6
7
8
9
10
MORGANZA
WEST ATCHAFALAYA FLOODWAY
MIDDLE BASIN
WAX LAKE OUTLET
LOWER ATCHAFALAYA RIVER
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
PROJECT FLOOD
DESIGN REACHES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-81



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

COMBINED OUTLETS RATING CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-82

PLATE C-82

APPENDIX D

ECONOMICS

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Appendix D

ECONOMICS

D.0.1. The purpose of this study was to review the Mississippi River and Tributaries (MR&T) project to develop the optimum method for passing the project flood and to determine if changes in the project would be warranted to preserve or restore the environmental quality of the Atchafalaya Basin. Alternatives were considered in order to address the study goals of flood control and environmental preservation, which included separable features considered to be responsive to individual problem areas. The types of features considered included those to control the distribution of flows between the Mississippi and Atchafalaya Rivers; those to safely pass the project flood through the Atchafalaya Basin to the Gulf of Mexico; those to manage water levels to enhance fish and wildlife productivity in the Atchafalaya Basin; those to provide flood protection for the backwater area northeast of Morgan City; and those to acquire additional real estate interests for flood control, public access, and environmental preservation.

D.0.2. Benefit-cost ratios were not developed for the overall plan alternatives since many features of each alternative would be integral parts of the comprehensive MR&T project. The flood control features of each alternative comprised these integral features and precluded overall plan evaluation. When the flood control aspects were not considered, plan alternative evaluation was reduced to an incremental analysis of the environmental and recreation aspects of each plan. What was produced was an analysis that measured the incremental impacts of the nonflood control features, assuming the flood control features were in place. Having identified the nonflood control features and their incremental impacts, the costs of these features were disaggregated from the overall plan alternative costs. Benefit-cost ratios were then calculated, which incorporated incremental nonflood control benefits and costs.

D.0.3. The study area delineated on Figure D-0-1, encompasses three interrelated geographical and hydrological elements: the Red River backwater area; the Atchafalaya Basin Floodway system; and the Lower Atchafalaya River complex, which includes the Terrebonne marshes, the backwater area northeast of Morgan City, and the Atchafalaya Bay. The impact area for all alternatives, however, was limited to the Atchafalaya Basin Floodway system (the Lower Atchafalaya Basin Floodway in particular) and the Lower Atchafalaya River complex. Of the two areas for which impacts were evaluated, only the Atchafalaya Basin Floodway

system included nonflood control features. In the Lower Atchafalaya River complex area all impacts evaluated were the result of flood control features and did not figure in the analysis performed for each plan alternative. The analysis performed was an incremental nonflood control evaluation of the Lower Atchafalaya Basin Floodway.

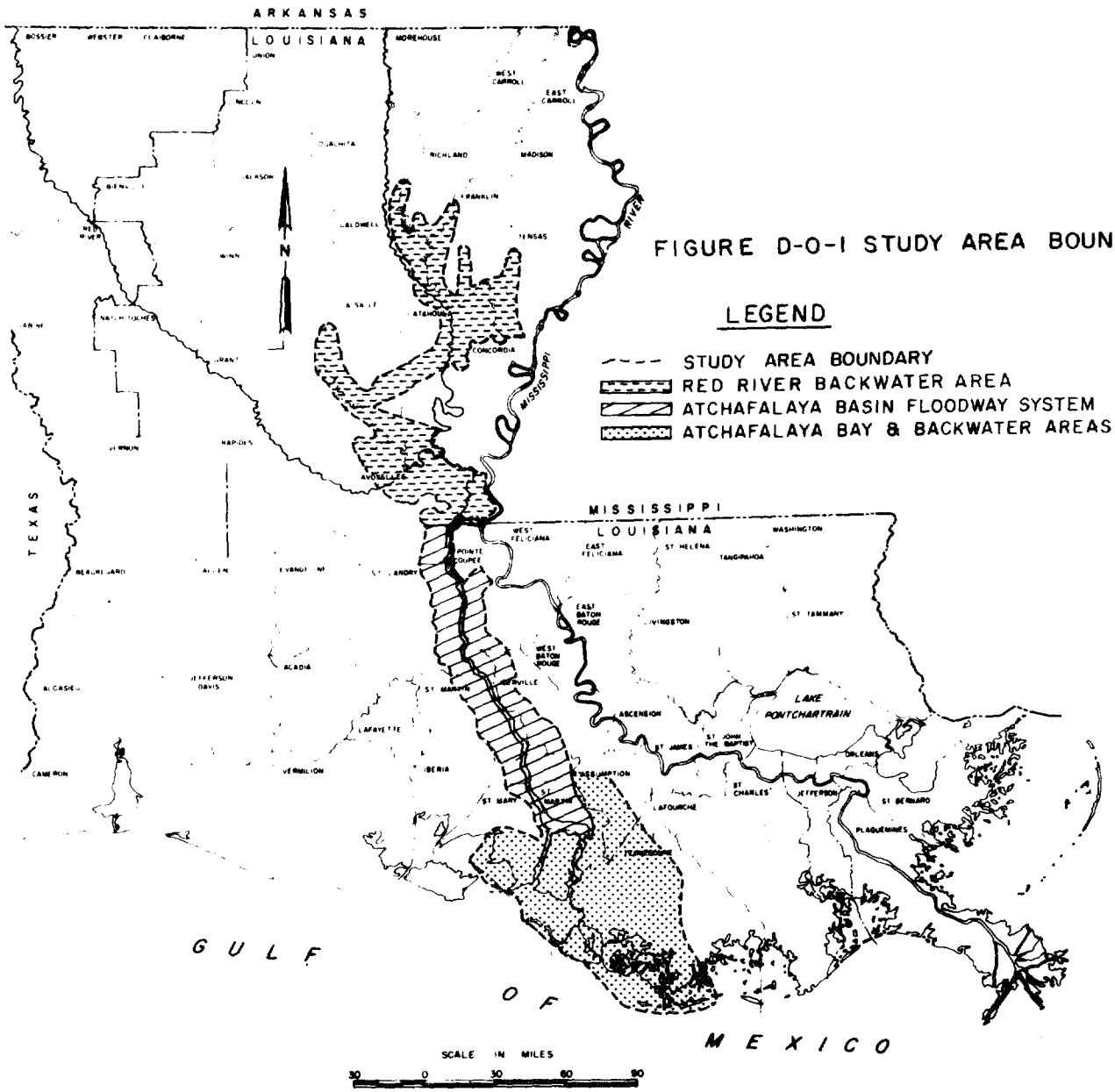

FIGURE D-O-1 STUDY AREA BOUNDARY

Section 1 - METHODOLOGY

OPERATIONAL PROCEDURES

D.1.1. Land use was the basis for computation of all benefit categories: agriculture, timber, recreation, commercial fishing, and commercial trapping. As quantities of a particular habitat which support specific economic activities change over time, so do the levels of output of the supported activities. The projection of the habitat associated with each alternative was central to the process of estimating the benefits attributable to a particular plan. In making these land-use projections, the effects of physical, as well as, economic forces were incorporated. The process of natural vegetative succession and impacts to the successional process from flowline changes, sedimentation, and water regime regulation (through management units) were several of the significant physical forces evaluated. Economic forces were also prominent factors in the projections, the most significant being the profit potential that motivates conversion of bottomland hardwoods to agricultural production. To accommodate the benefit estimation process, 10-year interval land-use acreage was projected for terrestrial and aquatic habitats. The corresponding output levels then were estimated and converted to net income equivalents, which were discounted and amortized to produce average annual net income for each activity. This procedure was completed using an October 1981 price level, a discount rate of 7-5/8 percent, and a 100-year period of analysis.

D.1.2. With respect to the land-use projections, there were several operational considerations and assumptions made that should be noted.

D.1.3. First, in addition to the area inside the Lower Atchafalaya Basin Floodway levees, the land-use acreage used to represent that area also included the area bounded by a line one-quarter mile east of the East Atchafalaya Basin Protection Levee north of Bayou Sorrel and a line one-quarter mile west of the West Atchafalaya Basin Protection Levee north of Verdunville. This allowed construction impacts, some of which would occur outside the lower floodway, to be properly accounted for. The inclusion of this area outside the guide levees added approximately 16,000 terrestrial and 3,000 aquatic acres to the total acreage figures. As a result, the absolute level of output and the corresponding net income generated for some activities was incorrectly stated by a slight amount. However, because this imprecision occurred under both the with and without-project conditions, the increments between the with and without conditions (benefits) were accurately measured.

D.1.4. Second, the land-use acreage for the Environmental Quality (EQ), Tentatively Selected (TS), and recommended plans assumed that the Buffalo Cove, Henderson Lake, Flat Lake, Cocodrie Swamp, and Beau

Bayou management units would be constructed. In fact, only the Buffalo Cove and Henderson Lake management units would be scheduled for pilot construction.

D.1.5. Third, the land-use acreage for the EQ, TS, and recommended plans, unlike the National Economic Development (NED) plan and future without-project condition, assumed a prohibition on land clearing for agricultural purposes as of 1980, although project authorization could not occur for several years. The real estate feature of these plans included a restriction on nonregenerative cutting of timber and conversion of land to another use. As a means of preserving bottomland hardwoods until project authorization and implementation could occur, it was assumed that the permitting authority (Section 404 of the Clean Water Act, 1977, PL 95-217) would be invoked to restrict specific types of development, land clearing in this case.

D.1.6. Fourth, land use was projected by decade for a period of 50 years. For the second 50 years of the 100-year period of analysis, land use was assumed to be constant as of the last projected value. The output level and the corresponding net income of all economic activities were held constant during this period. While there would be changes in land use due to both physical and economic forces during the second 50 years, the inherent difficulties in attempting to project for such an extended period of time and the minimizing effects of discounting on benefits and costs which would accrue during this period, make the procedure followed here generally accepted practice.

D.1.7. Finally, the year 1986 was selected as the first year of the project life. This was done because it would be the earliest reasonable date that authorization and appropriations could be obtained and construction begun.

Section 2 - BENEFITS

GENERAL

D.2.1. This section presents the procedures used to compute the levels of net income associated with each plan alternative for the following economic activities: agriculture, forestry, recreation, commercial fishing, and commercial trapping. Benefits to each plan were measured by the difference between the average annual net income figures with and without the plan. This section presents the net income for all economic activities for each alternative. Only those plans versus future without-project increments in average annual income that occurred as a result of nonflood control features were properly viewed as benefits for this incremental analysis of nonflood control impacts.

AGRICULTURE

D.2.2. General. Existing agricultural activity in the Lower Atchafalaya Basin Floodway is not extensive. It is limited primarily to pasture, with a small amount of acreage in soybeans. All of this activity occurs north of Interstate Highway 10 and is generally confined to the higher, more accessible grounds.

D.2.3. Bottomland Hardwoods Conversion. The most probable future without-project condition for the lower floodway involves the conversion of approximately 187,000 acres of bottomland hardwoods to agricultural production (Table D-2-1). The forces behind this significant change are both physical and economic. As shown by Figure D-2-1, the number of acres in the lower floodway that are flood free (defined here as flood free during the period 1 June to 30 November) at least three out of five years increases from approximately 236,000 acres to approximately 335,000 acres. The continued channel enlargement of the Atchafalaya River and the process of sediment deposition in the flooded overbank areas are the factors responsible for this drying-out process. More important perhaps than physical forces are the economic forces that motivate the conversion of forestland to soybean production.

D.2.4. Net Returns From Soybeans. The potential income earning capacity of the typical acre of land that could be used to grow soybeans in the lower floodway is the driving force behind the large projected conversion of forestland to agricultural production. Table D-2-2 presents the estimated costs and returns that would be generated on a typical acre. The projected land clearing shown in Table D-2-1 includes acres that would be flood free three or more out of five years. To adjust the annual net return to land and management to reflect the occurrence of flooding, which was assumed to prevent that

TABLE D-2-1

ACRES IN AGRICULTURAL PRODUCTION

Year	Future Without-Project	Plan			
		NED	EQ	TS	Recommended
1980	15,200	15,200	15,200	15,200	15,200
1986	23,000	23,000	15,600	15,600	15,600
1996	60,900	62,300	16,200	16,200	16,200
2006	125,000	131,000	16,700	16,700	16,700
2016	173,000	183,000	17,300	17,300	17,300
2026	196,000	210,000	17,900	17,900	17,900
2036	202,000	218,000	18,100	18,100	18,100
2086	202,000	218,000	18,100	18,100	18,100

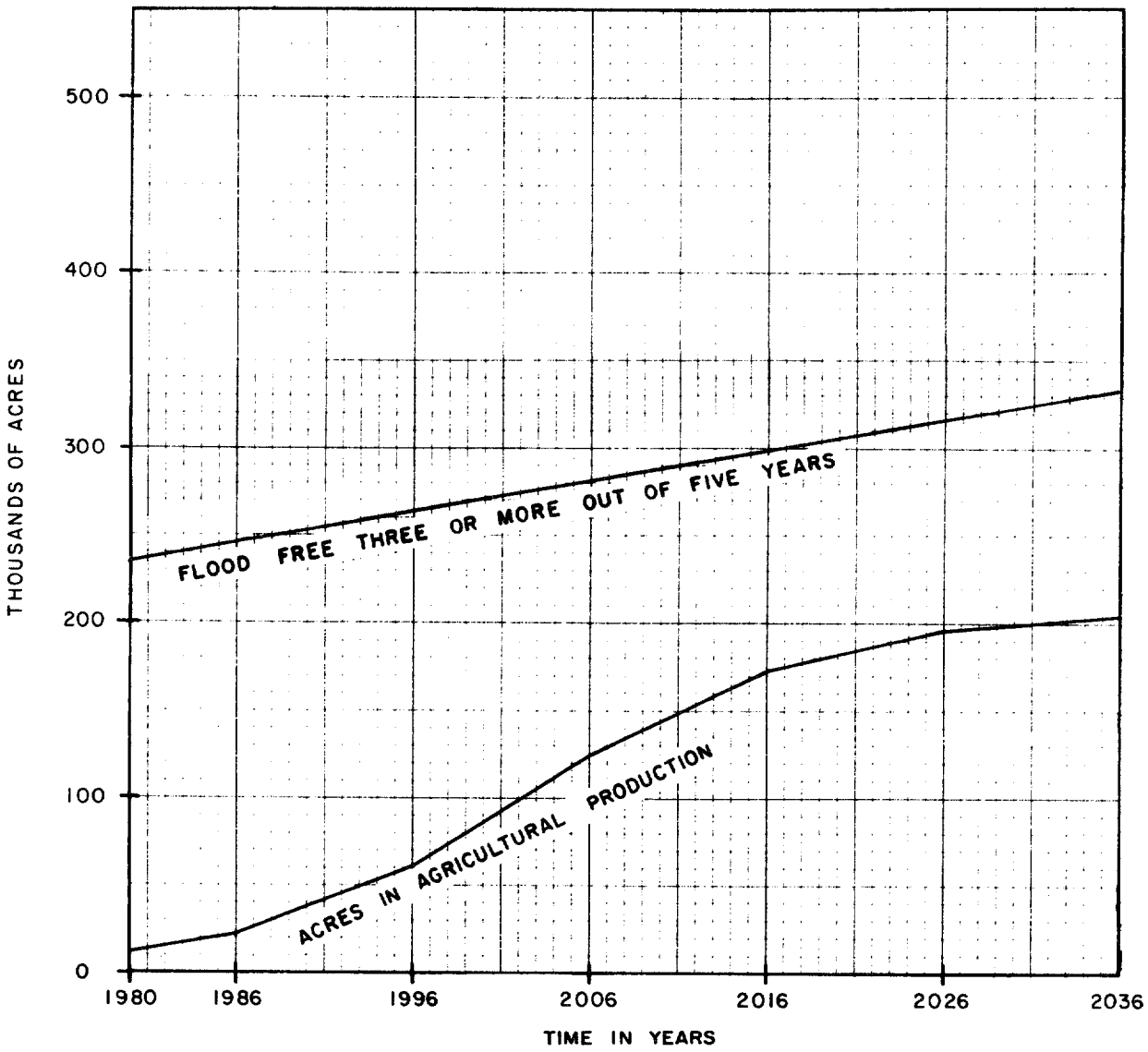

FIGURE D-2-1 MOST PROBABLE FUTURE WITHOUT PROJECT
LOWER ATCHAFALAYA BASIN FLOODWAY

TABLE D-2-2

ESTIMATED ANNUAL COSTS AND RETURNS
ON FORESTLAND CONVERTED TO SOYBEANS
(PER ACRE)

Gross Receipts $6.35/bushel x 29 bushel/acre		$184.15[1/]
Variable Costs		
Preharvest	$64.54	
Harvest	$11.33	$ 75.87
Fixed Costs		$ 32.92
Total Production Costs		$108.79[2/]
Net Returns to Land and Management		$ 75.36
Adjustment to Average Annual Income to Account for Occasional Flooding	(0.20 x $75.36)	$ 15.07
Flood Adjusted Average Net Return		$ 60.29
Clearing Costs		$ 25.94[3/]
Fully Costed Average Net Return		$ 34.35

1/ $6.35/bushel price is the Water Resources Council 1981 normalized price for soybeans in Louisiana; 29 bushel/acre yield is the composite 1975-78 average yield for Iberville, Pointe Coupee, St. Landry, and St. Martin Parishes.

2/ Crop budget data developed by Louisiana State University.

3/ Annual clearing cost is based on an initial cost of $340/acre amortized at 7-5/8 percent for a period of 100 years.

year's crop, the average net return must be reduced. As an absolute maximum, this reduction would be 40 percent, the two out of five years when flooding occurs. The actual reduction, however, should be less than 40 percent. This is due to several reasons. First, not all lands projected to be cleared would flood two out of five years. Some would flood only one out of five, while others would not flood at all. Second, the flood frequency of lands cleared early would continue to be reduced as the area became drier over time. If an acre flooded one out of five years at the time of its clearing, its flood frequency could decrease to none out of five over time as conditions changed. A third consideration is the assumption regarding flooding. If land has water on it after 1 June, it was assumed there would be no crop that year. If, however, the waters recede shortly after 1 June it would be possible to plant late and receive reduced yields, yet still generate positive net income. For these reasons, it was assumed that the average frequency of flooding on future cleared lands would be one out of five years. This would result in an average net return to land and management that would be 20 percent less than the annual net return figure.

D.2.5. It is profit potential that motivates a landowner to convert his land to soybean production. The flood adjusted average net return from soybean production, as presented in Table D-2-2, is approximately $60 per acre. Alternatives to soybean production do not provide comparable levels of income. Net returns from forestry (on a sustained yield basis) are approximately $15 to $20 per acre, while annual net returns from hunting leases are limited between $2 to $4 per acre. At best, a private landowner can earn on average approximately $20 per acre (exclusive of mineral income) on an acre of bottomland hardwoods. This means that landowners could earn in excess of $40 per acre net of opportunity cost. The present value of a $40 annuity for 100 years at 7-5/8 percent is equal to approximately $525. Given an initial conversion cost for land clearing and preparation of approximately $340 per acre, it is apparent that the profit-maximizing landowner would convert his land from forestland to soybean production, since the landowner's benefit-cost evaluation does not take into account externalized benefits or costs that do not accrue to him.

D.2.6. Table D-2-3 presents the net income that would be generated by the conversion of forestland to soybean production under the future without-project condition.

D.2.7. NED Plan. Compared to the future without-project condition, the NED plan generates a lower flowline in the Lower Atchafalaya Basin Floodway. This would accelerate and amplify the physical forces responsible for the drying-out process and would render additional acres of bottomland hardwoods subject to potential conversion. As a result, a larger number of acres would be in soybean production (see Table D-2-1).

TABLE D-2-3

NET RETURNS FROM SOYBEAN PRODUCTION FOR
FUTURE WITHOUT-PROJECT CONDITION

Year	Acres In Production	Average Net Returns Per Acre[1/]	Net Returns
		($)	($)
1986	23,000	40.04	921,000
1996	60,900	43.49	2,649,000
2006	125,000	40.04	5,005,000
2016	173,000	36.39	6,295,000
2026	196,000	35.17	6,893,000
2036	202,000	34.35	6,939,000
2086	202,000	34.35	6,939,000
1986-2086 Average Annual			3,173,000

[1/] After initial conversion to soybean production, the productivity of the land is above average for a period of approximately five years. Yields during this period would be about one standard deviation above the mean value or 33 bushels per acre (see footnote 1, Table D-2-2). At this higher yield, the fully costed average net return per acre would be $54.67. The average net return per acre value presented here is the weighted average of acres considered "cleared within the last five years," with net returns per acre of $54.67 and "not cleared within the last five years," with net returns per acre of $34.35.

D.2.8. The net income generated from soybean production under the NED plan is presented in Table D-2-4. The increase in net returns for the 50-year period, 1986-2036, is dramatic, showing a greater than eight-fold increase. This increase, however, when viewed against the without-project condition, is only slightly greater than would otherwise occur.

D.2.9. EQ, TS, and Recommended Plans. The EQ, TS, and recommended plans would prevent the conversion of bottomland hardwoods to agricultural production in the lower floodway. As part of a real estate package, which includes flood control and environmental easements, these plans would prohibit non-regenerative timber cutting and land clearing for conversion to other land uses. This prohibition would extend generally over the entire lower floodway. The profit motive for conversion of forestland to agricultural production would not be removed, but it would be legislatively neutralized. Table D-2-5 presents the agricultural net income associated with the EQ, TS, and recommended plans.

D.2.10. Table D-2-5 requires two explanatory notes. As previously discussed under methodology, the EQ, TS, and recommended plans assumed no land clearing within the lower floodway after 1980. This assumption explains the apparent inconsistency between alternatives of a different number of acres in production at the start of the project life. Land clearing would occur during the period 1980 to 1986 with the future without-project condition and with the NED plan but not with the EQ, TS, and recommended plans. The second clarification concerns the slight increase in acres in production and the corresponding increase in net returns. Again, as discussed previously, the land-use figures provided for the lower floodway included a small amount of acreage outside the floodway levees. It is on this land outside the floodway levees that the land conversion and increase in production will occur. This explains how acres in production could increase in view of the restriction on land conversion in the lower floodway.

D.2.11. Summary. The variance in average annual agricultural net income between plans would be substantial. Table D-2-6 presents these differences. As can be seen, the NED plan, which would have the greatest net income, is nearly six times greater than the EQ, TS, or recommended plans.

TIMBER

D.2.12. Evolution of Atchafalaya Basin Logging. Prior to 1890, cypress was cut in anticipation of the spring high water. There were few protection levees in Louisiana at that time and most of the south Louisiana swamps were flooded each spring by high waters from the Mississippi River and its distributaries. Timber cutters worked

TABLE D-2-4

NET RETURNS FROM SOYBEAN PRODUCTION FOR
THE NED PLAN

Year	Acres In Production	Average Net Returns Per Acre[1/]	Net Returns
		($)	($)
1986	23,000	40.04	921,000
1996	62,300	43.49	2,709,000
2006	131,000	40.24	5,271,000
2016	183,000	36.39	6,659,000
2026	210,000	35.36	7,426,000
2036	218,000	34.35	7,488,000
2086	218,000	34.35	7,488,000
1986-2086 Average Annual			3,312,000

[1/] After initial conversion to soybean production, the productivity of the land is above average for a period of approximately five years. Yields during this period would be about one standard deviation above the mean value or 33 bushels per acre (see footnote 1, Table D-2-2). At this higher yield, the fully costed average net return per acre would be $54.67. The average net return per acre value presented here is the weighted average of acres considered "cleared within the last five years," with net returns per acre of $54.67 and "not cleared within the last five years," with net returns per acre of $34.35.

TABLE D-2-5

NET RETURNS FROM SOYBEAN PRODUCTION FOR
THE EQ, TS, AND RECOMMENDED PLANS

Year	Acres In Production	Average Net Returns Per Acre[1/]	Net Returns
		($)	($)
1986	15,600	34.75	542,000
1996	16,200	34.75	563,000
2006	16,700	34.75	580,000
2016	17,300	34.75	601,000
2026	17,900	34.75	622,000
2036	18,100	34.35	622,000
2086	18,100	34.35	622,000
1986-2086 Average Annual			569,000

[1/] After initial conversion to soybean production, the productivity of the land is above average for a period of approximately five years. Yields during this period would be about one standard deviation above the mean value or 33 bushels per acre (see footnote 1, Table D-2-2). At this higher yield, the fully costed average net return per acre would be $54.67. The average net return per acre value presented here is the weighted average of acres considered "cleared within the last five years," with net returns per acre of $54.67 and "not cleared within the last five years," with net returns per acre of $34.35.

TABLE D-2-6

SUMMARY OF NET RETURNS FROM AGRICULTURE

Year	Future Without-Project	Plan			
		NED	EQ	TS	Recommended
	($)	($)	($)	($)	($)
1986	921,000	921,000	542,000	542,000	542,000
1996	2,649,000	2,709,000	563,000	563,000	563,000
2006	5,005,000	5,271,000	580,000	580,000	580,000
2016	6,295,000	6,659,000	601,000	601,000	601,000
2026	6,893,000	7,426,000	622,000	622,000	622,000
2036	6,939,000	7,488,000	622,000	622,000	622,000
2086	6,939,000	7,488,000	622,000	622,000	622,000
1986-2086 Average Annual	3,173,000	3,312,000	569,000	569,000	569,000

through the winter and early spring felling and bucking the trees prior to the yearly high water. When the water rose, the logs were floated through the network of bayous to the principal stream of navigation where the logs were rafted together and towed to the sawmills. At times, the spring rise failed to come and logs had to lie in the swamps for an entire year. This caused heavy losses and often the sawmills were shut down because no logs were available.

D.2.13. As the cypress lumber industry developed, the experienced operators began to seek new solutions to the access and transport problem. With the invention of the "pullboat," the sawmills were no longer dependent on the annual high water and were unaffected by droughts.

D.2.14. The "pullboat," invented by William Baptist of New Orleans in 1889, was capable of pulling logs one-half mile and two others built later would each pull 3,000 feet. In 1891, the Louisiana Cypress Lumber Company of Harvey inaugurated the first pullboat, followed by the first overhead skidder. The Louisiana Red Cypress Company of Patterson and the Ruddock Cypress Company of Ruddock, in 1892 and 1894, respectively, replaced the pullboat with the railroad skidder. Because of low first cost and efficiency, this method replaced virtually all others.

D.2.15. The next improvement in logging was the "Baptist" type overhead skidder, built by Woodward, Wight and Company of Louisiana. Patents of these machines were obtained by Lidgerwood Manufacturing Company of New York and were known locally as Lidgerwood skidders. The overhead cableway skidder was universally used in the swamps of south Louisiana. These tree-rigged skidders could log a million board feet a month with an average crew of 17 at a cost of less than one dollar per thousand.

D.2.16. Thus, logging progressed from the float in the 1880's to the pullboat in the 1890's, and from that to the overhead cableway skidder, which was used until the supply of virgin cypress was exhausted in the 1920's.

D.2.17. Present Logging Methods. Present-day swamp logging in the cypress-tupelo areas of south Louisiana is limited chiefly to two methods: truck hauling and water transportation by barge, the latter being generally more expensive.

D.2.18. Typically, the timber is first cut with power saws. Cables, called chokers, are next placed on the logs and several logs are hooked together behind an amphibious vehicle known as a bombadier. These logs are then skidded to a loading point on a road; the choker cables are detached and the logs are loaded on a truck by means of a hydraulic loader. This type logging is generally limited to areas within one-half mile of the access road, since it is not practical to

skid logs for distances greater than 2,500 feet. These vehicles are relatively slow and maintenance costs are high. A typical truck haul logging operation using bombadiers for skidders will produce about 10,000 board feet per day. Minimum timber volumes per acre to economically justify this type logging are in the range of 2,000 to 2,500 board feet.

D.2.19. The other type logging method commonly used in south Louisiana involves transporting the logs by barge. With this method, the timber is cut in the usual manner and skidded to the bank of a navigable stream or canal by use of bombadiers or barge-mounted, long-line skidders. When bombadiers are used, the logs are hooked to the machine with cable chokers and pulled to the stream bank where a barge-mounted loader places them onto a barge. The long-line skidder is sometimes used instead of the bombadier. This is a diesel-powered machine that utilizes cables for skidding logs from the woods to the river bank. Most present-day long-line skidders can pull logs a maximum distance of about 1,500 feet; however, there are heavy-duty machines capable of pulling distances up to 3,000 feet. None of these larger machines are presently operating in south Louisiana.

D.2.20. In a very few cases, accessibility can be achieved by constructing board roads or canals. The cost, however, is almost always prohibitive, since there is little timber in south Louisiana today that would justify the $8-10 per linear foot construction costs for board roads or canals. Because skidding distances are limited to a maximum of 2,500 feet, roads have to be spaced at about one-mile intervals. The cost of this approximates $80.00 per acre. As with board roads, the canals should be no farther than one mile apart; this entails a cost of about $65.00 per acre. Timber volume per acre would have to exceed 5,000 board feet to justify construction of either logging canals or board roads.

D.2.21. In recent years, a new method for harvesting south Louisiana cypress-tupelo areas has been initiated. This new method involves cutting the timber in the usual manner and transporting it with the use of helicopters. This practice, while relatively new, is currently being used to supply a recently constructed sawmill in the area. If this new method of helicopter harvest proves viable, it could have a significant impact on the merchantability of many previously inaccessible areas.

D.2.22. On the bottomland hardwood areas in the northern portions of the lower floodway, conventional track logging utilizing rubber-tired skidders occurs on the more accessible areas.

D.2.23. Net Returns to Logging. It is apparent from the preceding discussion that not all of the total standing timber in the basin at present is considered to be "merchantable", i.e., it could actually be sold on the open market. Considering current timber prices, logging

costs, and the factors previously discussed, the harvestable timber resource (merchantable) is severely limited. For this analysis, two basic criteria were used in establishing merchantability: the minimum volume per acre must exceed 2,000 board feet; and the timber must be located within some 2,500 feet of a navigable stream or roadway. Timber acreage meeting these criteria range from a high of 80 percent in the Alabama Bayou management unit to a low of 30 percent in the southernmost management units.

D.2.24. Timber acreage was further subdivided into two classes: late successional bottomland hardwoods (LSBLHW), which occur on higher lands, and, other timber, which includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW and CT, and acreage of unknown composition. Each of these two main classes has been assigned specific merchantable percentages and net return values.

D.2.25. Impacts of the various plans on the amount of timber acreage identified as merchantable were estimated on a decade basis and the resulting changes in annual net returns reduced to an average annual figure, using present worth (discount) methods. Projection rationale and other values for the discounting parameters are discussed in the section on methodology.

D.2.26. The chief impacts associated with each alternative plan, as compared to the future without-project condition, have been identified by different future flowlines of the river and the related effects therefrom on vegetative succession, and by the various real estate easement proposals that will regulate future land uses.

D.2.27. Future Without-Project Condition. The most probable future without-project condition for the lower floodway involves the conversion of approximately 187,000 acres of bottomland hardwoods to agricultural production. The forces behind this significant change are both physical and economic. As discussed under agriculture, the number of acres in the lower floodway that are flood free at least three out of five years increases from approximately 236,000 acres to approximately 335,000 acres. The continued channel enlargement of the Atchafalaya River and the process of sediment deposition in the flooded overbank areas are the factors responsible for this drying-out process. In addition, there are powerful economic forces that motivate the conversion of forestland to soybean production. This also is discussed in the preceding section on agriculture.

D.2.28. The combined impacts discussed previously would result in projected merchantable acreage of LSBLHW and other timber classes as shown in Table D-2-7, and an average annual net return of $3,047,000 as shown in Table D-2-8.

D.2.29. NED Plan. No restrictions on land conversions are included in the NED Plan, thus the same profit incentives for conversion of forestlands to agriculture as described in the future without-project

TABLE D-2-7

MERCHANTABLE[1/] TIMBER ACREAGE
FUTURE WITHOUT-PROJECT CONDITION

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	126,500	95,000
1996	112,500	91,400
2006	84,500	89,300
2016	65,500	87,500
2026	57,000	86,400
2036	55,000	86,400
2086	55,000	86,400

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-8

NET RETURNS FROM MERCHANTABLE[1/] TIMBER
FUTURE WITHOUT-PROJECT CONDITION

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,530,000	1,045,000	3,575,000
1996	2,250,000	1,006,000	3,256,000
2006	1,690,000	982,000	2,672,000
2016	1,310,000	962,000	2,272,000
2026	1,140,000	950,000	2,090,000
2036	1,100,000	950,000	2,050,000
2086	1,100,000	950,000	2,050,000
1986-2086 Average Annual			3,047,000

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

condition would operate. Further, the NED plan would generate a lower flowline in the Lower Atchafalaya Floodway as compared to the future-without project. This would accelerate and amplify the drying-out process and would result in additional clearing of merchantable timber. The combined effect of the above, summarized on Table D-2-9 and D-2-10, would result in an annual net return to timber of $3,021,000 for this plan.

D.2.30. EQ, TS, and Recommended Plans. The EQ, TS, and recommended plans would prevent the conversion of bottomland hardwoods to agricultural production in the lower floodway. As part of a real estate package, which includes flood control and environmental easements, these plans would prohibit non-regenerative timber cutting and land clearing for conversion to other land uses. This prohibition would extend generally over the entire lower floodway. The profit motive for conversion of forestland to agricultural production would not be removed but it would be legislatively neutralized. Tables D-2-11 through D-2-16 present the acreage of timber and the net income from timbering associated with the EQ, TS, and recommended plans. Annual income from the EQ and TS plans amounts to $3,112,000 and $3,113,000, respectively. The slight difference between the two plans comprised a minor difference in construction impacts to timber acreage associated with each plan. Annual income from the recommended plan amounts to $3,077,000. The difference in annual income between the recommended and the two previously mentioned plans occurs due to a difference in the number of acres on which silviculture would be prohibited as part of real estate easements.

D.2.31. Summary. The impacts of each alternative plan on the net income (return) to timbering operations in the floodway represent a range of approximately 3 percent between the least impacting plan and the most impacting plan, as summarized in Table D-2-17.

RECREATION

D.2.32. General. The Lower Atchafalaya Basin Floodway offers diverse recreational opportunities to satisfy the pursuits of a wide spectrum of outdoor enthusiasts. The two major recreational activities, hunting and fishing, are sustained by the great abundance of wildlife and fishery resources of the area.

D.2.33. Of approximately 590,000 acres that lie within the lower floodway below US Highway 190, approximately 80 percent is in private ownership. More than 250 private hunting clubs have their own permanent camps in the northern portion of this area (Miller, personal communication). Many of these clubs lease lands from private landowners on an annual basis. Public hunting is restricted more to state-owned lands, such as the Attakapas and Atchafalaya Delta Wildlife Management Areas or to public water bodies.

TABLE D-2-9

MERCHANTABLE[1/] TIMBER ACREAGE
NED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	126,500	95,000
1996	112,000	91,400
2006	83,000	88,600
2016	62,500	85,700
2026	53,500	83,900
2036	51,000	83,500
2086	51,000	83,500

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-10

NET RETURNS FROM MERCHANTABLE[1/] TIMBER
NED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,530,000	1,045,000	3,575,000
1996	2,240,000	1,006,000	3,246,000
2006	1,660,000	974,000	2,634,000
2016	1,250,000	942,000	2,192,000
2026	1,070,000	923,000	1,993,000
2036	1,020,000	919,000	1,939,000
2086	1,020,000	919,000	1,939,000
1986-2086 Average Annual			3,021,000

1/ Recoverable.
2/ Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-11

MERCHANTABLE[1/] TIMBER ACREAGE
EQ PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	108,000	84,200
1996	111,000	81,700
2006	110,500	82,400
2016	110,000	83,900
2026	109,500	85,300
2036	109,500	86,000
2086	109,500	86,000

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-12

NET RETURNS FROM MERCHANTABLE[1/] TIMBER
EQ PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,160,000	927,000	3,087,000
1996	2,220,000	899,000	3,119,000
2006	2,210,000	907,000	3,117,000
2016	2,200,000	923,000	3,123,000
2026	2,190,000	939,000	3,129,000
2036	2,190,000	946,000	3,136,000
2086	2,190,000	946,000	3,136,000
1986-2086 Average Annual			3,112,000

1/ Recoverable.
2/ Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-13

MERCHANTABLE[1/] TIMBER ACREAGE
TS PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	108,000	84,200
1996	111,000	81,700
2006	110,500	82,400
2016	110,000	84,200
2026	110,000	85,700
2036	110,000	86,400
2086	110,000	86,400

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-14

NET RETURNS FROM MERCHANTABLE [1/] TIMBER
TS PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,160,000	927,000	3,087,000
1996	2,220,000	899,000	3,119,000
2006	2,210,000	907,000	3,117,000
2016	2,200,000	927,000	3,127,000
2026	2,200,000	942,000	3,142,000
2036	2,200,000	950,000	3,150,000
2086	2,200,000	950,000	3,150,000
1986-2086 Average Annual			3,113,000

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-15

MERCHANTABLE[1/] TIMBER ACREAGE
RECOMMENDED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	106,000	84,600
1996	109,000	82,100
2006	108,500	82,800
2016	108,000	84,600
2026	108,000	86,000
2036	108,000	86,800
2086	108,000	86,800

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-16

NET RETURNS FROM MERCHANTABLE[1/] TIMBER
RECOMMENDED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,120,000	931,000	3,051,000
1996	2,180,000	903,000	3,083,000
2006	2,170,000	911,000	3,081,000
2016	2,160,000	931,000	3,091,000
2026	2,160,000	946,000	3,106,000
2036	2,160,000	954,000	3,114,000
2086	2,160,000	954,000	3,114,000
1986-2086 Average Annual			3,077,000

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-17

SUMMARY OF NET RETURNS FROM MERCHANTABLE[1/] TIMBER

Year	Future Without-Project	Plan			
		NED	EQ	TS	Recommended
	($)	($)	($)	($)	($)
1986	3,575,000	3,575,000	3,087,000	3,087,000	3,051,000
1996	3,256,000	3,246,000	3,119,000	3,119,000	3,083,000
2006	2,672,000	2,634,000	3,117,000	3,117,000	3,081,000
2016	2,272,000	2,192,000	3,123,000	3,127,000	3,091,000
2026	2,090,000	1,993,000	3,129,000	3,142,000	3,106,000
2036	2,050,000	1,939,000	3,136,000	3,150,000	3,114,000
2086	2,050,000	1,939,000	3,136,000	3,150,000	3,114,000
1986-2086 Average Annual	3,047,000	3,021,000	3,112,000	3,113,000	3,077,000

[1/]Recoverable.

D.2.34. Since the open water of the lower floodway is public domain, fishing occurs on a year-round basis throughout the area but is more concentrated in the southern part. Both sport and rough fish are taken.

D.2.35. Several commercial campgrounds are located in the project area. Campgrounds generally offer sites having electrical hookups, water and sanitation facilities and, in some instances, boat-launching ramps to enter the basin.

D.2.36. The Lower Atchafalaya Basin Floodway, because of its environmental uniqueness and its classification as Louisiana's largest river swamp, provides a focal point for the pursuit of many nonconsumptive recreational activities. Nature seekers engage in canoeing, photography, nature study, and exploring. Such visitors seek out the scenic semi-wilderness areas of hardwood forests, cypress swamps, marshes, and bayous that teem with a wide diversity of flora and fauna. Commercial operations, catering to the nature enthusiast, are increasing and offer such services as basin tours and guided canoe outings.

D.2.37. Evaluated Impacts. The evaluated impacts to existing recreational activities in the lower floodway resulted from two plan-induced factors: land-use (habitat) changes and the construction of specific recreation features, which would constitute a recreation development plan.

D.2.38. The impacts of land-use changes were evaluated for only three activities: big game hunting, small game hunting, and waterfowl hunting. Habitat types were projected in 10-year intervals and along with the biological carrying capacities associated with each habitat type, the man-days of supply generated for each hunting activity were estimated. The man-days of supply were converted to monetary terms by multiplying the estimated supply by unit-day prices for each activity.

D.2.39. The impacts of the recreation development plan were evaluated by estimating the number and type of recreational visitations that would be generated by construction of the associated features and facilities. These visitations would be over and above the level of each activity that would occur in the absence of plan implementation. Having estimated annual visitations, the annual monetary value of the various activities was computed by multiplying the visitations by the unit price of each activity.

D.2.40. Appendix F, Recreation Resources, provides a detailed presentation of the recreation impacts as well as a complete description of the recreation development features. Appendix F includes calculation of the man-days of supply for each alternative and the annual visitations generated by the recreation development plan. For a discussion of the unit-day values applied to the computed

man-days of supply and annual recreation development visitations, refer to the Summary of Related Studies section of this appendix.

D.2.41. The recreation impacts of the future without-project condition are presented in Table D-2-18. The without-project condition does not incorporate recreation development features; therefore, the impacts evaluated were limited to changes in the man-days of supply for the three hunting activities. As Table D-2-18 shows, the man-days of supply would decrease over time for all activities. The primary reason for this projected decline is the drying-out process that is currently underway in the lower floodway. As the Atchafalaya River enlarges its main channel and the process of sediment deposition in the overbank areas continues, habitat that supports wildlife would be lost as bottomland hardwoods become suitable for agriculture and are converted to soybean production.

D.2.42. NED Plan. The NED plan would result in similar losses of wildlife habitat as with the future without-project condition. These losses would be slightly greater than the future without-project condition as the lower flowline associated with the NED plan allows a greater amount of bottomland hardwoods to be converted to agricultural production. Table D-2-19 presents a summary of the recreation impacts associated with the NED plan, including the impacts of the recreation development features that would be a part of the NED plan.

D.2.43. EQ, TS, and Recommended Plans. These plans would incorporate real estate easements, which would prohibit non-regenerative timber cutting and land clearing for conversion to other land uses. These easements would extend generally over the entire lower floodway and would work to preserve the wildlife-supporting habitat. In addition, the EQ and TS plans would also provide public access to approximately 50,000 acres of cypress-tupelo and 30,000 acres of bottomland hardwood habitat, while the recommended plan would provide public access to approximately 12,000 acres of cypress-tupelo and 66,000 acres of bottomland hardwood habitat. Higher biological carrying capacities resulting from wildlife management practices on these acres would generate a larger number of man-days of supply when compared to the future without-project condition for these acres.

D.2.44. Tables D-2-20, D-2-21, and D-2-22 present the respective man-days of supply for the EQ, TS, and recommended plans. The man-days of supply presented were adjusted to reflect that no hunting would occur on approximately 1,500 acres purchased in fee, which would be required for implementation of the recreation development features. The impacts of the recreation development features are also presented in Tables D-2-20 through D-2-22.

TABLE D-2-18

RECREATION SUMMARY
FOR FUTURE WITHOUT-PROJECT CONDITION

Year	User Days Supplied			Total Value[1/] ($)
	Big Game	Small Game	Waterfowl	
1986	77,200	60,900	1,900	4,227,000
1996	70,400	56,400	1,800	3,871,000
2006	58,300	50,100	1,600	3,266,000
2016	50,000	45,300	1,400	2,841,000
2026	46,400	43,100	1,400	2,657,000
2036	45,700	42,700	1,400	2,622,000
2086	45,700	42,700	1,400	2,622,000
1986-2086 Average Annual				3,648,000

[1/] Total value represents the total of the three hunting activities discussed previously. Other recreation activities, such as fishing and general recreation, are not included.

TABLE D-2-19

RECREATION SUMMARY FOR THE NED PLAN

Year	User Days Supplied				Recreation Development[1/] Annual Visitations			
	Big Game	Small Game	Waterfowl	Total Value ($)	General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	77,200	60,900	1,900	4,227,000	705,500	320,100	16,551,000	20,778,000
1996	70,700	57,000	1,800	3,894,000	705,500	320,100	16,551,000	20,445,000
2006	58,000	49,500	1,500	3,241,000	705,500	320,100	16,551,000	19,792,000
2016	48,900	44,200	1,400	2,778,000	705,500	320,100	16,551,000	19,329,000
2026	45,000	41,900	1,300	2,577,000	705,500	320,100	16,551,000	19,128,000
2036	44,000	33,400	1,300	2,393,000	705,500	320,100	16,551,000	18,944,000
2086	44,000	33,400	1,300	2,393,000	705,500	320,100	16,551,000	18,944,000
1986-2086 Average Annual				3,631,000			16,551,000	20,182,000

[1/] These visitations are above the existing level of general recreation and fishing visitations.

TABLE D-2-20

RECREATION SUMMARY FOR THE EQ PLAN

Year	User Days Supplied				Recreation Development[1/] Annual Visitations			
	Big Game	Small Game	Waterfowl	Total Value ($)	General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	86,800	63,800	2,000	4,670,000	705,500	549,800	17,273,000	21,943,000
1996	87,500	64,300	2,000	4,707,000	705,500	549,800	17,273,000	21,980,000
2006	87,800	64,200	2,000	4,718,000	705,500	549,800	17,273,000	21,991,000
2016	88,400	64,300	2,000	4,744,000	705,500	549,800	17,273,000	22,017,000
2026	88,900	64,200	2,000	4,763,000	705,500	549,800	17,273,000	22,036,000
2036	89,200	64,300	2,000	4,777,000	705,500	549,800	17,273,000	22,050,000
2086	89,200	64,300	2,000	4,777,000	705,500	549,800	17,273,000	22,050,000
1986-2086 Average Annual				4,708,000			17,273,000	21,981,000

[1/] These visitations are above the existing level of general recreation and fishing visitations.

TABLE D-2-21

RECREATION SUMMARY FOR THE TS PLAN

Year	User Days Supplied				Recreation Development[1/] Annual Visitations			
	Big Game	Small Game	Waterfowl	Total Value ($)	General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	86,800	63,800	2,000	4,670,000	705,500	549,800	17,273,000	21,943,000
1996	87,500	64,400	2,000	4,709,000	705,500	549,800	17,273,000	21,982,000
2006	87,900	64,200	2,000	4,722,000	705,500	549,800	17,273,000	21,995,000
2016	88,500	64,300	2,000	4,748,000	705,500	549,800	17,273,000	22,021,000
2026	89,200	64,400	2,000	4,778,000	705,500	549,800	17,273,000	22,051,000
2036	89,500	64,500	2,000	4,792,000	705,500	549,800	17,273,000	22,065,000
2086	89,500	64,500	2,000	4,792,000	705,500	549,800	17,273,000	22,065,000
1986-2086 Average Annual				4,710,000			17,273,000	21,983,000

[1/] These visitations are above the existing level of general recreation and fishing visitations.

TABLE D-2-22

RECREATION SUMMARY FOR THE RECOMMENDED PLAN

Year	User Days Supplied				Recreation Development[1/] Annual Visitations			
	Big Game	Small Game	Waterfowl	Total Value ($)	General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	96,400	65,900	2,100	5,098,000	705,500	320,100	16,551,000	21,649,000
1996	97,200	66,500	2,100	5,141,000	705,500	320,100	16,551,000	21,692,000
2006	97,500	66,300	2,000	5,147,000	705,500	320,100	16,551,000	21,698,000
2016	98,100	66,400	2,000	5,173,000	705,500	320,100	16,551,000	21,724,000
2026	98,800	66,500	2,000	5,203,000	705,500	320,100	16,551,000	21,754,000
2036	99,100	66,600	2,100	5,220,000	705,500	320,100	16,551,000	21,771,000
2086	99,100	66,600	2,100	5,220,000	705,500	320,100	16,551,000	21,771,000
1986-2086 Average Annual				5,141,000			16,551,000	21,692,000

[1/] These visitations are above the existing level of general recreation and fishing visitations.

COMMERCIAL FISHING

D.2.45. General. The NED benefits to commercial fishing attributable to project alternatives are defined as the incremental effects of those alternatives on the income of harvesters of fish (fishermen). For purposes of estimating these impacts for this report, certain modifications were made to the study, "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin," F. Bell, 1981. This report served as the major source of information for the calculation of commercial fishing benefits. Modifications to the results are described subsequently. The purpose of these adjustments was to present the findings of the study in a format that would be compatible with the Water Resources Council (WRC) publication, "Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resources Planning (Level C); Final Rule," hereafter referred to as WRC procedures.

D.2.46. Budget Adjustments. As described in the summary of the Bell study of commercial fishing and trapping (Section 6 of this appendix), a major task in that study was the development of a budget for the representative fishermen in the Atchafalaya Basin. To make this budget compatible with the WRC procedures, it was necessary to make certain adjustments to the Bell budget as shown in Table D-2-23.

D.2.47. Clarification of the data presented in Table D-2-23 requires the inclusion of the following:

- The Bell budget was based on Bell's Table 6.4, Estimated Earnings and Cost, Crawfish and Finfish Fishermen (simulated full-time).

- The WRC procedures require that a management fee equal to 10 percent of the variable costs be included in the budget.

- Bell's depreciation charge hinged on the assumption that the fisherman's capital equipment (truck, boat, and trailer) was used exclusively for business purposes. A more appropriate assumption would be that these items would actually be used 50 percent for business and 50 percent for personal use, hence the reduction in the depreciation charged.

- The insurance charge was deleted in the adjusted budget since it should be attributed to personal and not to business use.

- The WRC procedures require that a capital charge equal to the dollar value of the capital employed in the enterprise times the project interest rate be assigned to the budget. Only that portion of the capital equipment actually utilized in the business would be used to calculate this charge as was the case with depreciation.

TABLE D-2-23

ESTIMATED REVENUE AND COSTS OF FULL-TIME FISHERMEN

Item	Bell Budget	Adjusted Budget
	($)	($)
Revenue	28,190	28,190
Variable Cost	14,520	14,520
Management Fee	-	1,452
Depreciation	3,100	1,550
Insurance	100	-
Cost of Capital	1,905	484
Wages	-	7,373
Total Costs	19,625	25,379
Profit	8,565	2,811
Profit Rate	Not Applicable	10 Percent

- Wages are a cost of the business enterprise and must be included in the budget according to the WRC procedures. The opportunity cost of labor was assumed to be $3.20/hour, the typical wage for agricultural labor in Atchafalaya Parishes. It was further assumed that the fisherman invests 8 hours per day for 288 days in his fishing operation.

- Bell's profit figure is actually the net return to capital, labor, and management. Although the fisherman receives all three forms of income in a cash-flow sense, this figure as calculated by Bell is not profit as defined in the WRC procedures.

- The profit rate as measured here is useful in determining plan benefits, i.e., the benefit of any alternative would be equal to the incremental revenue times 0.10. This profit rate is not what economists generally refer to as a profit rate, since the usual meaning of such a term is the percentage return on invested capital (rate of return on equity capital.)

D.2.48. Maximum Sustainable Yield. In his study, Bell used a bio-economic model of the fisheries to estimate the maximum sustainable yield (MSY) of the principal basin species. Because the value of the crawfish harvest was 78 percent of the total value of all commercial fish harvested in the basin over the period 1976-1979, (Table D-2-24), and because the modeling results with crawfish were significantly more successful than with the other species, Bell used the crawfish harvest to estimate all the commercial fishing benefits. The multiplier used to expand the crawfish revenue into total commercial fishing revenue was 1.28 (or the inverse of 0.78).

D.2.49. Since crawfish were the key to estimating the commercial fishing benefits, the MSY of crawfish became an important input to the benefit evaluation. Bell has estimated, using the National Marine Fisheries (NMF) data, that the current MSY for crawfish is 16 million pounds, as described in the summary of the Bell study (Section 6 of this appendix). Bell also used the "Atchafalaya Basin Usage Study" (Usage Study) as a data source. According to the Usage Study, the landings of commercial fish were considerably in excess of the numbers generated by the NMF survey. To account for these differences, it was decided to inflate the crawfish MSY by 2.67, which was the weighted multiplier for adjusting the NMF data to the Usage Study. Thus, the current MSY (high estimate) became 43 million pounds of crawfish annually. When the value of this harvest was then multiplied by 1.28, the resultant was Bell's estimate of the total revenue of the commercial fish harvest in the basin.

D.2.50. Bell's estimated crawfish MSY of 43 million pounds was calculated for current (1980) conditions. The physical processes of continued channel enlargement of the Atchafalaya River and sediment

TABLE D-2-24

POUNDS AND VALUE OF FISH AND SHELLFISH FOR THE ATCHAFALAYA BASIN [1/]

Species	1976		1977		1978		1979 [2/]	
	Pounds	Value ($)	Pounds	Value ($)	Pounds	Value ($)	Pounds	Value ($)
Bowfin	13,200	945	11,500	1,014	3,700	356	13,600	1,406
Buffalo	726,900	108,587	836,200	129,733	1,365,700	231,959	2,055,400	353,113
Carp	105,100	4,272	59,800	2,959	61,500	3,235	131,800	10,128
Catfish	644,600	225,585	631,900	228,216	660,400	270,170	613,600	255,509
Garfish	75,900	11,029	93,700	15,996	130,500	25,375	158,500	34,280
Paddlefish	3,100	249	2,700	254	14,900	1,759	30,600	3,349
Gou	354,300	52,582	345,500	52,448	203,900	32,307	527,600	87,068
Shad	573,100	21,735	654,600	31,039	413,100	25,644	474,100	48,343
Crawfish	5,620,100	1,692,063	1,310,900	708,413	13,941,700	4,107,092	5,524,500	1,981,940
Freshwater Turtle	9,100	4,013	6,900	3,247	13,400	5,016	29,900	16,249
Frog	25,000	19,075	21,000	19,969	33,500	47,492	15,400	15,166
River Shrimp	2,500	1,750	2,000	1,392	4,800	3,663	8,500	6,376
Total	8,152,900	2,141,885	3,976,700	1,194,680	16,847,100	4,754,068	9,583,500	2,812,927

[1/] National Marine Fisheries Service as cited in "Commerical Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin", F.W. Bell, 1981.
[2/] Preliminary, subject to revision

deposition in the flooded overbank areas are responsible for the drying-out process presently underway in the lower floodway. This drying-out process is associated with the loss of fisheries-supporting habitat and, over time, would be responsible for reductions in the current MSY level. Table D-2-25 presents the estimated levels of MSY for each plan alternative, as well as for the future without-project condition using Bell's estimate as a starting point. As can be seen, the MSY would decrease under all conditions. This reduction would be greatest with the NED plan, which has the lowest flowline and the most accentuated drying-out effects. The EQ, TS, and recommended plans, while showing a decline, would not result in as great a reduction as the NED plan or future without-project condition due to the habitat-preserving features that they include. These features include the real estate easements that would prevent development and conversion of forestland to cropland, as well as the construction of management units that would regulate water levels to the benefit of the fish and wildlife resources.

D.2.51. Computation of Benefits. Bell estimated a growth of demand for crawfish that indicated that the current MSY would be reached in year 1994. After that, prices (real price of crawfish) would continue to rise with quantity supplied fixed at 16 million pounds (or 43 million pounds using the higher usage study data). The benefit to any alternative would be the net income associated with the difference between that project alternative's MSY and the MSY of the future without-project condition after 1992. The MSY becomes the constraint after 1992, because Bell's research indicated that demand for crawfish would exceed the estimated MSY's for all conditions by 1992. In effect, what he found was that demand would be sufficient to clear the market of all crawfish supplied. Thus, any project alternative that lowers the MSY below that of the future without-project condition would have a negative commercial fishing benefit. For purposes of quantifying the benefits, the differences in revenue between each alternative and the future without-project condition were derived from the Bell data. This revenue difference was then multiplied by the net income factor of 10 percent (see paragraph on budget adjustments). The resultant figure was then multiplied by 1.28 to get the net income for the entire fisheries.

D.2.52. Summary. Table D-2-26 presents the estimated net income figures for each plan alternative and the future without-project condition. The NED plan would result in only a moderate reduction, approximately 6 percent, in the average annual net income it would generate when compared to the future without-project condition. However, when compared to the EQ, TS, or recommended plans the reduction would be more significant, approximately 15 percent. This reduction was limited to only 15 percent because until 1992, MSY for all conditions would exceed the level of demand, and despite a greater decline in MSY for the NED versus the future without-project condition, there would be no difference in net income between plans.

TABLE D-2-25

MAXIMUM SUSTAINABLE YIELDS
(MILLIONS OF POUNDS)

Year	Future Without-Project	Plan			
		NED	EQ	TS	Recommended
1986	43.00	43.00	42.22	42.22	42.22
1996	37.14	35.76	39.35	39.32	39.32
2006	32.40	30.38	36.87	36.85	36.85
2016	28.79	25.74	34.35	34.34	34.34
2026	26.73	23.01	31.61	31.61	31.61
2036	26.11	22.24	30.60	30.58	30.58
2086	26.11	22.24	30.60	30.58	30.58

TABLE D-2-26

SUMMARY OF COMMERCIAL FISHING NET INCOME

Year	Future Without-Project	NED	EQ	TS	Recommended
	($)	($)	($)	($)	($)
1986	2,800,000	2,800,000	2,800,000	2,800,000	2,800,000
1996	5,470,000	5,200,000	5,800,000	5,790,000	5,790,000
2006	7,300,000	6,860,000	8,310,000	8,310,000	8,310,000
2016	8,690,000	7,770,000	10,380,000	10,370,000	10,370,000
2026	10,160,000	8,740,000	12,020,000	12,020,000	12,020,000
2036	10,730,000	9,140,000	12,570,000	12,570,000	12,570,000
2086	10,730,000	9,140,000	12,570,000	12,570,000	12,570,000
1986-2086 Average Annual	5,820,000	5,460,000	6,400,000	6,400,000	6,400,000

D.2.53. Net income for all conditions is projected to increase over time despite a projected decrease in fisheries-supporting habitat and a resulting decline in MSY. These increases in net income would occur as a result of the continually increasing real price of crawfish (an increase in the relative price of crawfish versus other commodities).

COMMERCIAL TRAPPING

D.2.54. General. Commercial trapping is a relatively small industry in the Atchafalaya Basin and in recent years has accounted for less that 5 percent of the total value of the commercial catch of fish and fur bearing animals (Table D-2-27). Commercial trapping is, however, for some fishermen, an important adjunct activity that they pursue for a few months of the year. As with commercial fishing, a few species dominate the fur-harvesting industry. In the basin, nutria, raccoon, and mink collectively accounted for more than 96 percent of the value of trapping in the period 1971-74 (Table D-2-28). Recent estimates of the fur-bearing harvest in the basin placed the value of the catch at approximately $300,000 to $400,000 (Table D-2-29). Louisiana's output of furs has little or no effect on the price of pelts since the total output of the state is miniscule relative to world supply. For purposes of the analysis, this condition was assumed to prevail throughout the period of analysis, and the real price of pelts was assumed to remain unchanged.

D.2.55. Budget Adjustments. As described in the summary of the Bell study of commercial fishing and trapping (see Section 6 of this appendix), a major task of that study was the development of a budget for the representative trapper in the Atchafalaya Basin. As with the budget that Bell developed for the representative fisherman, it was necessary to make adjustments to the trapper's budget in order to make it compatible with the WRC procedures. These adjustments are shown in Table D-2-30. Clarification of the data presented in Table D-2-30 requires the inclusion of the following:

- The Bell budget was based on the 1978-1979 budget presented in the Bell report.

- The WRC procedures require that a management fee equal to 10 percent of the variable costs be included in the budget.

- Bell did not include a depreciation charge in his trapping budget. Since commercial trappers, typically, are also commercial fishermen and since they ordinarily own the same equipment, i.e., boat, trailer, etc., it was assumed that this

TABLE D-2-27

COMPARISON OF THE ECONOMIC IMPORTANCE OF COMMERCIAL FISHING AND TRAPPING IN THE ATCHAFALAYA RIVER BASIN[1/]

Year	Commercial Fishing	Commercial Trapping	Total	Percent Trapping of Total
	($)	($)	($)	($)
1971-72 [2/]	4,641,000	82,000	4,723,000	1.7
1972-73 [3/]	9,632,000	233,000	9,865,000	2.4
1973-74 [3/]	4,536,000	199,000	4,735,000	4.4

[1/] Atchafalaya Basin Usage Study (1975) as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin," F.W. Bell, 1981.
[2/] Represents grand totals or day and night combined.
[3/] Only day totals reported.

TABLE D-2-28

COMMERCIAL FUR CATCH IN THE ATCHAFALAYA RIVER BASIN [1]
(In Thousands)

Species	1971-72 Number[2]	1971-72 Value	1972-73 Number[2]	1972-73 Value	1973-74 Number[2]	1973-74 Value
		($)		($)		($)
Nutria	9	24	42	136	30	119
Raccoon	9	30	10	57	9	61
Mink	3	14	6	37	2	13
Muscrat	0	0	1	3	1	1
Beaver	[3]	1	0	0	0	0
Opposum	0	0	0	0	[3]	2
Other	0	0	0	0	[3]	4
Total		69		233		199

[1] Atchafalaya Basin Usage Study (1975) as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin," F.W. Bell, 1981.
[2] Day totals only.
[3] Less than 0.5.

TABLE D-2-29

ESTIMATED GROSS RECEIPTS FROM TRAPPING
IN THE ATCHAFALAYA RIVER BASIN[1/]

Species	Louisiana		Atchafalaya Basin [2/]	
	Number	Value($)	Number	Value($)
		1977-78		
Nutria	1,714,083	8,263,373	25,711	123,950
Raccoon	192,845	1,967,022	14,463	147,527
Mink	28,101	252,909	2,950	26,555
Total		10,483,304		298,032
		1978-79		
Nutria	1,145,084	4,823,094	17,176	72,421
Raccoon	231,747	3,383,507	17,381	253,763
Mink	51,731	465,579	5,432	48,886
Total		8,672,180		375,070

[1/] Louisiana Department of Wildlife and Fisheries as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin," F.W. Bell, 1981.

[2/] Nutria 1.5 percent of state.
Racoon 7.5 percent of state.
Mink 10.5 percent of state.

TABLE D-2-30

ESTIMATED REVENUE AND COST OF THE AVERAGE
ATCHAFALAYA RIVER BASIN TRAPPER

Item	Bell Budget	Adjusted Budget
Revenue	3,639	3,639
Variable Cost	875	875
Management Fee	-	88
Depreciation	-	388
Insurance	-	-
Cost of Capital	-	121
Wages	-	1,536
Total Costs	875	3,008
Profit	2,764	631
Profit Rate	Not Applicable	17 Percent

same equipment was used in the commercial trapping operation. Since commercial trapping is approximately a 3-month activity, the calculation of depreciation was $3,100 multiplied by 1/2 by 1/4 = $388, where $3,100 equaled the depreciation in the Bell budget (commercial fishing). One-half was the correction factor to adjust for the equipment being utilized 50 percent for business, and one-fourth represents the portion of the year that the equipment was utilized for commercial trapping.

- The WRC procedures require that a capital charge equal to the dollar value of the capital employed in the enterprise times the project interest rate be assigned to the budget. Only that portion of the capital equipment actually utilized in the business would be used to calculate this charge, as was the case with depreciation.

- Wages are a cost of the business enterprise and must be included in the budget according to the WRC procedures. The opportunity cost of labor in this instance was assumed to be $3.20/hour (same as commercial fishing). The amount of labor time invested in the operation was assumed to be 60 days times 8 hours per day for a total of 480 hours.

- Bell's profit figure is actually the net return to capital, labor, and management. Although the trapper receives all three forms of income in a cash flow sense, this figure as calculated by Bell is not profit as defined in the WRC procedures.

- The profit rate as measured here is a useful method in determining plan benefits, i.e., the benefit of any alternative would be equal to the incremental revenue times 0.17. This profit rate is not what economists generally refer to as a profit rate, since the usual meaning of such a term is the percentage of return on invested capital (rate of return on equity capital).

D.2.56. Computation of Benefits. The NED commercial trapping benefits were measured as the incremental net income to the trapper, comparing the future without-project condition to the various plan alternatives. In the preceding paragraph on budget adjustments, it was determined that net income to the trapper is on the average approximately 17 percent of total revenue. To estimate NED benefits, it was then necessary to develop a method for estimating catch levels and the corresponding total revenue.

D.2.57. As was the case in all previous benefit estimations, the projection of land use (habitat types) was essential. This also was true for commercial trapping. Given the biological carrying capacities for each habitat type for each of the three major species, it was possible to estimate a population size for a specific point in

time based on the land use. Therefore, using the land-use projections, population sizes for each of the major species were estimated over the project life. The next step was to estimate catch, having previously estimated the population. This was accomplished by multiplying the estimated population size by the ratio of the 1979 actual catch to the estimated 1979 population size. This catch-population relationship was assumed to remain constant for the project life. The estimated catch was multiplied by the 1976-80 average price to compute total revenue.

D.2.58. Having determined biological carrying capacities by habitat type, future land use, a catch-population relationship, and a representative price, the total revenue was estimated for each project alternative and the future without-project condition for specified points in time. An example of total revenue computation for the future without-project condition for 1986 is presented in Tables D-2-31 through D-2-33. These tables show the total revenue computation for mink, nutria, and racoon, respectively. The computation for the various plan alternatives was the same except that the habitat types associated with each plan alternative changed over time at different rates.

D.2.59. Summary. The procedure described in the preceding paragraph was used to generate a stream of total revenue figures associated with each plan alternative and the future without-project condition. The stream of total revenue for each condition was converted to net income to the fisherman by multiplying total revenue by the profit rate, 0.17.

D.2.60. These net income figures, as well as average annual values, are presented in Table D-2-34. It can be seen that the EQ, TS, and recommended plans effectively maintain the existing level of net income during the project life while the future without-project condition and the NED plan show a drop of approximately 30 percent in net income during the first 50 years of the project life. However, when viewed in terms of absolute amounts, the decrease in net income associated with these two conditions is not significant.

TABLE D-2-31

ESTIMATED MINK POPULATION, CATCH, AND REVENUE
FUTURE WITHOUT-PROJECT CONDITION

Habitat Type 1/	Carrying Capacity	1986 Acres	1986 Population
ESBLHW	0.05	73,800	3,690
LSBLHW	0.05	253,000	12,650
CT	0.10	173,000	17,300
MIX	0.10	10,400	1,040
CU	0.05	6,400	320
OPEN	0.00	23,500	0
Total Estimated 1986 Population			35,000
			x 0.153 2/
Estimated 1986 Catch			5,355
1976-80 Average Price			x $9.70
Total Revenue			$51,900

1/ ESBLHW - early successional bottomland hardwoods.
LSBLHW - late successional bottomland hardwoods.
CT - cypress-tupelo.
MIX - early successional bottomland hardwoods/cypress-tupelo.
CU - compostion unknown.
OPEN - cleared land/levees, etc.

2/ Ratio of the 1979 actual catch to the 1979 estimated population.

TABLE D-2-32

ESTIMATED NUTRIA POPULATION, CATCH, AND REVENUE
FUTURE WITHOUT-PROJECT CONDITION

Habitat Type 1/	Carrying Capacity	1986 Acres	1986 Population
ESBLHW	0.00	73,800	0
LSBLHW	0.00	253,000	0
CT	0.50	173,000	86,500
MIX	0.50	10,400	5,200
CU	0.00	6,400	0
OPEN	0.00	23,500	0
Total Estimated 1986 Population			91,700
			x 0.186 2/
Estimated 1986 Catch			17,056
1976-80 Average Price			x $5.71
Total Revenue			$97,400

1/ ESBLHW - early successional bottomland hardwoods.
LSBLHW - late successional bottomland hardwoods.
CT - cypress-tupelo.
MIX - early successional bottomland hardwoods/cypress-tupelo.
CU - compostion unknown.
OPEN - cleared land/levees, etc.

2/ Ratio of the 1979 actual catch to the 1979 estimated population.

TABLE D-2-33

ESTIMATED RACOON POPULATION, CATCH, AND REVENUE
FUTURE WITHOUT-PROJECT CONDITION

Habitat Type 1/	Carrying Capacity	1986 Acres	1986 Population
ESBLHW	0.066	73,800	4,920
LSBLHW	0.066	253,000	16,867
CT	0.066	173,000	11,533
MIX	0.066	10,400	693
CU	0.066	6,400	427
OPEN	0.000	23,500	0
Total Estimated 1986 Population			34,440
			x 0.498 2/
Estimated 1986 Catch			17,151
1976-80 Average Price			x $10.98
Total Revenue			$188,300

1/ ESBLHW - early successional bottomland hardwoods.
LSBLHW - late successional bottomland hardwoods.
CT - cypress-tupelo.
MIX - early successional bottomland hardwoods/cypress-tupelo.
CU - compostion unknown,.
OPEN - cleared land/levees, etc.

2/ Ratio of the 1979 actual catch to the 1979 estimated population.

TABLE D-2-34

SUMMARY OF COMMERCIAL TRAPPING NET INCOME

Year	Future Without-Project	Plan			
		NED	EQ	TS	Recommended
	($)	($)	($)	($)	($)
1986	57,000	57,000	58,000	58,000	58,000
1996	54,000	54,000	57,000	57,000	57,000
2006	49,000	48,000	57,000	57,000	57,000
2016	45,000	43,000	57,000	57,000	57,000
2026	43,000	41,000	57,000	57,000	57,000
2036	42,000	40,000	57,000	57,000	57,000
2086	42,000	40,000	57,000	57,000	57,000
1986-2086 Average Annual	52,000	52,000	57,000	57,000	57,000

Section 3 - SUMMARY OF COSTS, BENEFITS, AND BENEFIT-COST RATIOS

GENERAL

D.3.1. Table D-3-1 presents a summary of the nonflood control average annual benefits for the Lower Atchafalaya Basin Floodway. Table D-3-2 presents a summary of both flood control and nonflood control first costs, while Table D-3-3 presents this cost breakdown in average annual terms. Table D-3-4 displays the nonflood benefit-cost ratios for each plan alternative.

D.3.2. It should be noted that interest during construction has been computed and included in the nonflood control first costs. Interest during construction however, was not computed for the flood control first costs. The purpose of including interest during construction is to adjust total costs and the resulting annual costs to reflect that the projected benefit stream and the expenditure of construction costs do not necessarily begin simultaneously. This calibration of expenditure and benefit flows (accomplished here by interest during construction) is required for benefit-cost evaluation. As previously discussed, the flood control features of this plan represent integral parts of the ongoing comprehensive MR&T project. As such, these features are not subject to incremental economic evaluation. Because incremental economic evaluation is not required, and the benefit stream of the MR&T project has been ongoing for many years, interest during construction was not computed for the flood control costs.

TABLE D-3-1

SUMMARY OF AVERAGE ANNUAL NONFLOOD CONTROL BENEFITS
(In Thousands)

Category	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Agriculture	1/	2/	2/	2/
Timber	3/	65	66	30
Recreation				
Hunting	4/	1,060	1,062	1,493
Recreation Development	16,551	17,273	17,273	16,551
Commercial Fishing	5/	580	580	580
Commercial Trapping	6/	5	5	5
Total	16,551	18,983	18,986	18,659

1/ Annual gain of $139,000 is a result of flood control features.
2/ Annual loss of $2,604,000 is a result of nonflood control features. The cost of this foregone income is reflected in the nonflood control easement costs.
3/ Annual loss of $26,000 is a result of flood control features.
4/ Annual loss of $17,000 is a result of flood control features.
5/ Annual loss of $360,000 is a result of flood control features.
6/ No incremental impact versus the future without-condition.

TABLE D-3-2

FIRST COSTS
(In Thousands)

Item[1]	Plan NED	EQ	TS	Recommended
	($)	($)	($)	($)
Flood Control				
Construction Necessitated by Flowline Changes[2]	576,620	588,981	551,631	551,631
Channel Training Above Morgan City	52,450	52,450	52,450	52,450
Sediment Control	31,100	31,100	31,100	31,100
Outlet Control	20,000	10,830	10,830	10,830
Widen Wax Lake Outlet Overbank	90,500	90,500	90,500	90,500
Channel Training Below Morgan City	11,650	-	11,650	11,650
Avoca Island Levee Extension	56,212[3]	-	-	-
Simple Flowage Easements	32,149	21,510	21,510	19,732
Mitigation	46,844[4]	-	-	-
Total Flood Control	917,525	795,371	769,671	767,893
Nonflood Control				
Recreation Development	20,356[5]	20,043[6]	20,043[6]	20,043[6]
Management Units[7]	-	23,730	23,730	23,730
Freshwater Structures	-	8,109	8,109	8,109
Increase Sediment Through Wax Lake Outlet	-	21,300	-	-
Environmental Easements	-	114,866	114,866	100,538
Public Access Easements[8]	-	31,422	31,422	66,693
Canal Closures and Circulation Improvements	-	1,000	1,000	1,000
Sub Total	20,356	220,470	199,170	220,113
Interest During Construction[9]	1,552	16,811	15,187	16,784
Total	21,908	237,281	214,357	236,897
Total Project	939,433	1,032,652	984,028	1,004,790

1/ Each construction (non-easement) item includes 25 percent for contingencies, 8 percent for supervision and administration, and 8 percent for engineering and design, except for Recreation Development which includes 25 percent contingencies, 13 percent supervision and administration, and 12 percent engineering and design. Easement items include 25 percent for contingencies plus acquisition and resettlement costs.

2/ Includes changes to levees and floodwalls, locks, etc.

3/ Represents construction cost for first reach only. Total cost for full extension of channel alinement is $271,680,000.

4/ Includes costs for mitigation of only first reach of Avoca Island Levee Extension. Total mitigation requirements with full extension are $131,844,000.

5/ Includes $1,187,000 for fee acquisition of 1,500 acres required for construction of facilities.

6/ Includes $874,000 for fee acquisition of 1,500 acres required for construction. This cost for fee acquisition is less than the cost of fee acquisition associated with the NED plan because fee acquisition is accomplished assuming basin-wide comprehensive easements are in place. This reduces the incremental cost of fee acquisition to $874,000.

7/ Includes construction costs only. Required flowage easements are included in Environmental Easements.

8/ Does not include cost for fee acquisition of 1,500 required for recreation development. This cost is included in Recreation Development.

9/ Assumes construction period of two years.

TABLE D-3-3

ANNUAL COSTS
(In Thousands)

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Flood Control				
Interest and Amortization	70,007	60,687	58,726	58,590
Operation and Maintenance	14,673	14,439	15,606	15,606
Total	84,680[1/]	75,126	74,332	74,196
Nonflood Control				
Interest and Amortization	1,672	18,105	16,355	18,075
Operation and Maintenance	383	433	433	433
Total	2,055	18,538	16,788	18,508
Total Project	86,735[1/]	93,664	91,120	92,704

[1/] With full extension of the Avoca Island Levee total annual flood control costs would be $107,606,000 and total project annual costs would be $109,661,000.

TABLE D-3-4

NONFLOOD CONTROL BENEFIT-COST RATIOS
(In Thousands)

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Average Annual Benefits	16,551	18,983	18,986	18,659
Average Annual Costs	2,055	18,538	16,788	18,508
Net Benefits	14,496	445	2,198	151
Benefit-Cost Ratio	8.1 to 1	1.02 to 1	1.13 to 1	1.01 to 1

Section 4 - INCREMENTAL EVALUATION — RECREATION DEVELOPMENT PLAN

OVERALL VERSUS INCREMENTAL EVALUATION

D.4.1. The importance of the recreation development plan to the overall evaluation of nonflood features is presented in Table D-4-1. The annual benefits generated by the recreation development plan represented approximately 90 percent of the total annual nonflood control benefits of the EQ, TS, and recommended plans, and in the case of the NED plan, they represented 100 percent of the total.

TABLE D-4-1

RECREATION DEVELOPMENT BENEFITS AS A PERCENT OF TOTAL NONFLOOD CONTROL BENEFITS
(In Thousands)

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Total Annual Nonflood Control Benefits	16,551	18,983	18,986	18,659
Annual Recreation Development Benefits	16,551	17,273	17,273	16,551
Recreation Development as a Percent of Total	100	91	91	89

D.4.2. The fact that the recreation development plan accounted for such an overwhelming percentage of total benefits suggests that this feature should be considered as a separable feature and evaluated incrementally. (In the case of the NED plan, the evaluation of nonflood control features has produced an incremental evaluation of the recreation development plan. This is because recreation development represents the only nonflood control feature of the NED plan.) In addition to accounting for approximately 90 percent of total benefits, the fact that these benefits could be achieved by

construction of only those features associated with the development plan adds significantly to the case for incremental evaluation. Fee purchase of approximately 1,500 acres and construction of facilities on these acres would be the only requirements for the plan to be effective. Purchase of additional real estate easements to provide public access or to preserve fish and wildlife habitat would not be necessary for the development plan to achieve the stated level of benefits.

D.4.3. Identification of separable features usually involves considerable judgment. The extent to which project features are separable and require incremental evaluation must be made on a case-by-case basis. The ability to fully allocate costs in a nonarbitrary manner along with the ability to independently achieve stated output levels are important factors in making this determination. In the present case, a supportable defense could be made for incremental evaluation of the recreation development plan as a separable feature.

D.4.4. Table D-4-2 presents an incremental evaluation of the recreation development plan assuming all other nonflood control features are in place. As was suggested by the high percentage of total benefits that the development plan represented, the incremental evaluation produced a highly favorable economic justification. (It should be noted that the 1,500 acres required for construction of the recreation development facilities would result in some very minor losses to timber and recreational hunting. For purpose of incremental analysis, this would slightly increase the cost of the development plan.) Table D-4-3 presents an evaluation of the remaining nonflood control features exclusive of the development plan. With annual benefits approximately 90 percent less, while still carrying the majority of the annual costs (approximately 89, 88, and 89 percent, respectively, for the EQ, TS, and recommended plans), the remaining nonflood control features lacked tangible economic justification.

D.4.5. Inclusion of the recreation development facilities in the overall evaluation of nonflood control features results in an economically justified plan in tangible economic terms. When they are included, the EQ, TS, and recommended plans yield benefit-cost ratios of 1.02 to 1, 1.13 to 1, and 1.01 to 1, respectively (see Table D-3-4). In their absence, the EQ, TS, and recommended plans fall to 0.10 to 1, 0.12 to 1, and 0.13 to 1, respectively. These other nonflood control features, however, have been included in the Recommended plan because of the significant contribution that they make to the environmental quality account. While providing only limited tangible economic benefits, these features are considered to be justified on the basis of their intangible benefits and their contributions to the study goal of environmental protection.

TABLE D-4-2

INCREMENTAL EVALUATION OF RECREATION DEVELOPMENT

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Annual Benefits				
General Recreation	5,235,000	5,235,000	5,235,000	5,235,000
Fishing	11,316,000	12,038,000	12,038,000	11,316,000
Total	16,551,000	17,273,000	17,273,000	16,551,000
Annual Costs				
Interest and Amortization	1,672,000	1,646,000	1,646,000	1,646,000
Operation and Maintenance	383,000[1/]	383,000[1/]	383,000[1/]	383,000[1/]
Total	2,055,000	2,029,000	2,029,000	2,029,000
Benefit-Cost Ratio	8.1 to 1	8.5 to 1	8.5 to 1	8.2 to 1

[1/] Basis of O&M estimate is presented in Appendix F, Recreation Resources

TABLE D-4-3

EVALUATION OF NONFLOOD CONTROL FEATURES
VIEWED INCREMENTALLY OF RECREATION DEVELOPMENT

Item	Plan		
	EQ	TS	Recommended
	($)	($)	($)
Annual Benefits			
Agriculture	1/	1/	1/
Timber	65,000	66,000	30,000
Recreation	1,060,000 2/	1,062,000 2/	1,493,000 1/
Commercial Fishing	580,000	580,000	580,000
Commercial Trapping	5,000	5,000	5,000
Total	1,710,000	1,713,000	2,108,000
Annual Costs			
Interest and Amortization	16,459,000	14,709,000	16,429,000
Operation and Maintenance	50,000	50,000	50,000
Total	16,509,000	14,759,000	16,479,000
Benefit-Cost Ratio	0.10 to 1	0.12 to 1	0.13 to 1

1/ Annual loss of $2,604,000 is a result of nonflood control features. The cost of this foregone income is reflected in the nonflood control easement costs.

2/ Represents impacts other than those resulting from the recreation development plan.

Section 5 - LAND CLEARING PROJECTIONS

GENERAL

D.5.1. This section contains the background and basic assumptions used to project the conversion of bottomland hardwoods to agricultural production in the Lower Atchafalaya Basin Floodway.

BACKGROUND

D.5.2. The decline of bottomland hardwood forests in the lower Mississippi Valley has been reported in "Documentation, Chronology, and Future Projections of Bottomland Hardwood Habitat Loss in the Lower Mississippi Alluvial Plain," a contract study performed for the US Fish and Wildlife Service by HRB - Singer, Inc. That report, detailing the loss of bottomland hardwoods and other forestland in Louisiana, forms the basis for data shown in Tables D-5-1 and D-5-2. These tables show that hundreds of thousands of acres of bottomland hardwoods have been cleared in Louisiana over the last few decades and that the trend appears to be accelerating. Examination of the HRB - Singer, Inc., report indicates that the land clearing process eventually reaches a phase where the rate of clearing slows presumably because all of the acreage suitable for development is cleared. The basic assumptions in developing a land-clearing forecast for the Atchafalaya Basin are described subsequently. The overiding assumption, however, is that the owners of bottomland hardwood forests will continue to be motivated primarily by the expectations of profits. The trends described in the HRB - Singer, Inc., report will continue because the most valuable use of bottomland hardwood forests tends to be conversion to agricultural use, particularly soybeans. Land clearing on a large scale is a relatively new phenomenon in the basin but it is expected to result in the conversion of well over a hundred thousand acres in the next 50 years, which is not surprising when viewed from the record of what has happened in the lower Mississippi Valley during the past 50 years.

ASSUMPTIONS

D.5.3. The following paragraphs discuss the assumptions used in the land-clearing projections.

D.5.4. All privately owned land in the Lower Atchafalaya Basin Floodway, which is flood free three or more out of five years, between 1 June and 30 November, is subject to being cleared.

D.5.5. Land clearing will proceed from north to south as it has historically in the lower Mississippi Valley. The floodway was divided into three zones for purposes of projecting land clearing.

TABLE D-5-1

FOREST ACREAGE IN LOUISIANA

Parish	Total Bottomland Hardwoods		
	1957	1967	1977
Ascension	100,957	94,913	88,549
Assumption	148,420	137,348	128,515
Avoyelles	268,784	249,641	193,634
Caldwell	76,294	66,924	45,555
Catahoula	230,861	194,366	108,589
Concordia	321,538	246,243	158,232
East Carrol	90,180	60,607	42,191
Evangeline	15,910	13,540	11,777
Franklin	119,379	86,652	47,770
Grant	7,269	6,422	3,493
Iberia	88,087	86,504	83,818
Iberville	294,127	285,823	276,733
Jefferson	14,500	7,300	1,802
Lafayette	6,100	5,832	4,354
Lafourche	280,000	249,851	240,716
LaSalle	66,577	59,227	53,020
Madison	206,304	148,592	114,575
Morehouse	159,363	87,121	45,992
Orleans	12,200	8,000	0
Ouachita	97,821	90,060	79,854
Plaquemines	1,200	1,100	942
Pointe Coupee	200,742	176,113	144,424
Rapides	123,821	97,507	61,068
Richland	102,325	93,362	56,382
St. Charles	55,088	49,674	44,344
St. James	87,458	83,102	64,529
St. John the Baptist	72,300	70,782	69,209
St. Landry	243,014	225,395	190,289
St. Martin	337,200	321,402	305,800
St. Mary	54,560	41,388	33,083
Tensas	201,162	173,629	131,221
Terrebonne	77,837	52,088	43,055
Union	25,585	24,012	22,795
West Baton Rouge	73,664	71,018	58,717
West Carrol	29,524	27,168	15,105
West Feliciana	62,477	45,804	30,000
Total	4,352,628	3,738,510	3,000,132

TABLE D-5-2

FOREST ACREAGE
NET LOSS IN LOUISIANA

Parish	Total Bottomland Hardwoods	
	1957-1967	1967-1977
Ascension	6,044	6,364
Assumption	11,072	8,833
Avoyelles	19,143	56,007
Caldwell	9,370	21,369
Catahoula	36,495	85,777
Concordia	75,295	88,011
East Carrol	29,573	18,416
Evangeline	2,370	1,763
Franklin	32,727	38,882
Grant	847	2,929
Iberia	1,583	2,686
Iberville	8,304	9,090
Jefferson	7,200	5,498
Lafayette	268	1,478
LaFourche	30,149	9,135
LaSalle	7,350	6,207
Madison	57,712	34,017
Morehouse	72,242	41,129
Orleans	4,200	8,000
Ouachita	7,761	10,206
Plaquemines	100	158
Pointe Coupee	24,629	31,689
Rapides	26,314	36,439
Richland	8,963	36,980
St. Charles	5,414	5,330
St. James	4,356	18,573
St. John the Baptist	1,518	1,573
St. Landry	17,619	35,106
St. Martin	15,798	15,602
St. Mary	13,172	8,305
Tensas	27,533	42,408
Terrebonne	25,749	9,033
Union	1,573	1,217
West Baton Rouge	2,646	12,301
West Carrol	2,356	12,063
West Feliciana	16,673	15,804
Total	614,118	738,378

Zone 1 consists of Henderson Lake and Alabama Bayou, the two most northern management units. Zone 2 consists of all the other management units except Belle River and Sixmile Lake, which are in Zone 3.

D.5.6. A certain portion of the land that meets the flood-free condition will not be cleared for a variety of reasons. These reasons include limited access, poor drainage, small tracts, and general unsuitability for a profitable agricultural operation. It was assumed that in Zones 1 and 2, 80 percent of the flood-free land would ultimately be cleared. It was further assumed for reasons detailed subsequently that no land would be cleared in Zone 3.

D.5.7. Historically, land clearing, in an area starts slowly (learning phase), accelerates (development phase), and then tapers off (mature phase). This process is illustrated by Figure D-5-1.

D.5.8. For purposes of qualifying the impacts of the land-clearing process, the schedule of land clearing expected in the Atchafalaya Basin is presented in Table D-5-3.

D.5.9. For Zone 1, year 0 is assumed to be 1980, since the process of land clearing is already underway in the Henderson Lake area and, specifically, around Alabama Bayou. Since there is still a sizable amount of acreage yet to be cleared in the upper floodways and in Zone 1, it was assumed that year 0 would not occur in Zone 2 until 1995. To use Table D-5-3 to project land clearing, one must know the number of eligible acres and the zones. For instance, if there are 100,000 acres eligible for clearing in Zone 2 in 1995 (year 0), then it is expected that by 2010 (year 15) 40 percent, or 40,000 of these eligible acres, would be cleared.

TABLE D-5-3

PROJECTED SCHEDULE OF LAND CLEARING

Year	Percent of Eligible Acres Cleared	Incremental Percent Cleared
0-5	5	5
6-10	15	10
11-15	40	25
16-20	60	20
21-25	75	15
26-50	80	5

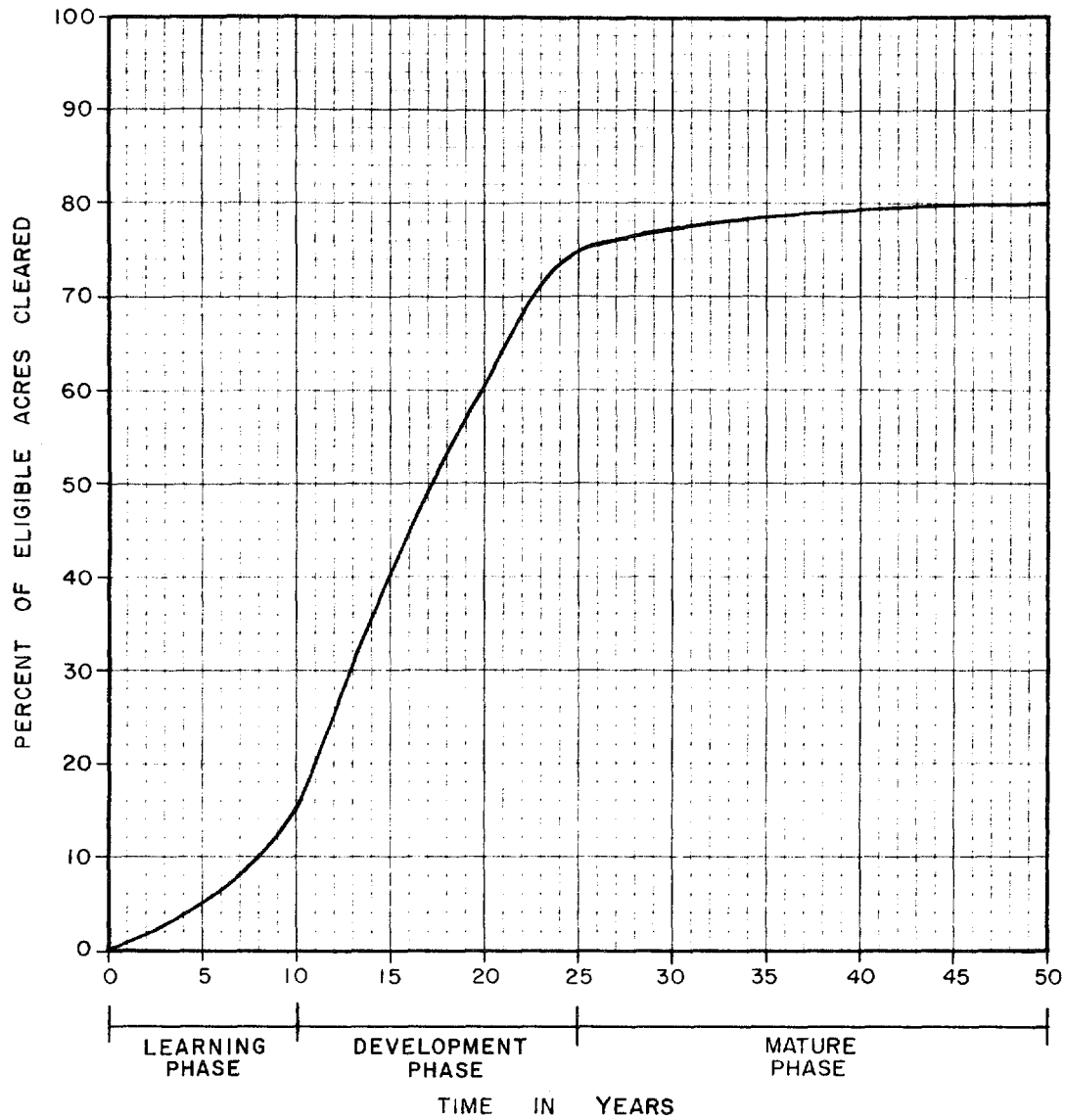

FIGURE D-5-1 CUMULATIVE LAND CLEARING CURVE

Section 6 - SUMMARY OF RELATED STUDIES

GENERAL

D.6.1. This section contains a summary of two studies conducted by Frederick W. Bell, Department of Economics, Florida State University. These two studies, "Recreational Benefits for the Atchafalaya River Basin," 1981, and "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin," 1981, were the principal sources used in the NED benefit estimation process.

RECREATIONAL BENEFITS FOR THE ATCHAFALAYA RIVER BASIN

D.6.2. Background. This study, conducted under US Fish and Wildlife Service (USFWS) Control Number 14-16-009-80-009, was funded by the US Army Corps of Engineers, New Orleans District, and jointly administered by the Division of Program Plans, USFWS, and the New Orleans District. The purpose of the study was to develop from existing data the recreational activity values (user-day values) specific to the Atchafalaya Basin. This study was originally conceived, contracted, and initiated prior to the WRC procedures. Nevertheless, it was the objective of the project managers of the contracting agencies and Bell to develop procedures and estimates of recreational activity values (benefits) that would be fully consistent with the requirements of WRC procedures.

D.6.3. Tasks. Several tasks essential to the estimation of the recreational activity benefits were performed by Bell. These were:

- The development of methods and models to analyze data for purpose of estimating fish-and-wildlife-related recreational benefits in the Atchafalaya Basin Floodway.

- The integration, to the maximum extent possible, of all available data and the estimation (with this data base) of the widest possible array of fish-and-wildlife-related recreational activities.

- The calculation of the present value of each recreational activity benefit stream, including the projection of future demand/supply conditions for each type of recreational activity in the basin.

D.6.4. Data Sources. Two basic data sources, utilized by Bell in the course of the research were:

o "Atchafalaya Basin Usage Study," US Army Corps of Engineers, New Orleans District, 1975.

- US Fish and Wildlife Computer Tape, "1975 National Survey of Hunting, Fishing, and Wildlife Associated Recreation."

D.6.5. Methodologies and Models. The basic test that any recreational benefit estimation technique must meet to be compatible with recent WRC procedures is that the technique simulate, as closely as possible, the willingness of consumers to pay for increments of the recreational resource (lake, nature trail, boat ramp, or whatever the subject alternative might be). Two techniques described in detail in WRC procedures are the travel cost method (TCM) and the contingent valuation method (CVM). The data requirements of the TCM were not met by the available data. This was also the case with the CVM. Bell chose to estimate the recreational activity benefits through use of the hedonic valuation method. According to Bell:

> Recent developments in estimating the economic value of wildlife recreation has centered around the use of what is called the household production function by viewing the individual recreationist as both individual consumer and producer. In particular, the US Fish and Wildlife Service has extensively explored the use of the hedonic method in estimating wildlife benefits.
> Thus, the hedonic approach relies upon the demand for the characteristics of a good (e.g., three days of hunting deer with four kills-bag).

D.6.6. It should be noted that the end product of the hedonic valuation technique, as employed in Bell's study, is a demand curve (or schedule) for the recreational experience, e.g., a typical small game hunter would be willing to pay a certain amount of money for a given number of days of small game hunting of a given quality. Ideally, one quality variable would be the site itself, i.e., the Atchafalaya Basin. In this way, the researcher could evaluate the difference that a consumer would be willing to pay for a hunting day in the Atchafalaya Basin as opposed to a substitute site. Unfortunately, the "Atchafalaya Basin Usage Study" did not query recreationists about alternative sights outside the basin. To the extent that Bell's values capture willingness to pay for the experience even above willingness to pay for the site, then these values overstate the benefits of the recreational activity and should be viewed as an upper limit to recreational activity values. However, it should also be noted that many users and potential users of the Atchafalaya Basin have suggested that sites of similar quality are either nonexistent or are in very short supply. Evidence indicates that in future years this supply of alternative recreational sites (particularly for deer hunting) will shrink at a significant rate. Thus, it is not unreasonable to accept the proposition that in the Atchafalaya Basin, the demand for a recreational activity, such as deer hunting cannot be divorced from site. Simply stated, alternative

sites (of comparable quality) are extremely limited and for many users, even the alternative of a significantly lower quality site is limited.

D.6.7. User-Day Values. In his study, Bell reports several sets of hedonic valuation estimates and contrasts these valuation estimates with those generated by other methodologies and by other researchers. The diversity of values contained in these other studies (and in Bell's own work) is explained, at least in part, by the methodological differences themselves, the deficiencies in the various data bases, and the differences in geographical regions. In the Bell study, however, there is only one set of estimates that covers a wide enough array of activities to be useful in calculating recreational activity benefits for the Atchafalaya Basin study. These values in 1975 dollars are presented in Table D-6-1.

D.6.8. The values presented in Table D-6-1 were updated to 1981 dollars by using the US Department of Commerce Purchasing Power of the Dollar index as measured by consumer prices. These updated values are presented in Table D-6-2.

D.6.9. The Bell user-day values in 1981 dollars and the most recent Water Resources Council Principles and Standards (P&S) unit-day value ranges are presented in Table D-6-3 for purposes of comparison. It should be noted that the use of P&S values in this study is prohibited by WRC procedures which limit the use of the unit-day value method to studies involving less than 500,000 annual visits. Because the recreation development features of this study alone generate in excess of 1.2 million annual visits, the Bell estimates which represent the site-specific willingness to pay were used. Also worthy of note is the benefit-cost evaluation of the recreation development features allowing the P&S values. Although generally lower than the Bell values, the use of mid-range P&S values would generate annual benefits of sufficient amount to produce a benefit-to-cost ratio of 2.0 to 1 for the EQ and TS plans and 1.6 to 1 for the NED and recommended plans.

COMMERCIAL FISHING AND TRAPPING: AN ECONOMIC ANALYSIS OF THE ATCHAFALAYA RIVER BASIN

D.6.10. Background. This present study of the economics of the commercial fishing and trapping industry is, to the best of Bell's knowledge, the first study of its kind. Previous studies of the Atchafalaya Basin have focused on the culture, sociology, and folklore of the region but have not attempted to qualify, in a systematic way, the contributions of commercial fishing and trapping industries to the regional and national economy.

TABLE D-6-1

ATCHAFALAYA BASIN RECREATION VALUES
IN 1975 DOLLARS

Activity	Value Per Day ($)[1/]
Big Game Hunting	23.64
Small Game Hunting	9.79
Waterfowl Hunting	15.41
Bank Fishing	1.82
Boat Fishing	20.75
Permanent Camping	17.00
Other Nonconsumptive	4.30

[1/] Bell (1981) Table 2.20, except for Other Nonconsumptive, which is from Table 2.13.

TABLE D-6-2

ATCHAFALAYA BASIN RECREATION VALUES
IN 1981 DOLLARS

Activity	Value Per Day ($)
Big Game Hunting	40.78
Small Game Hunting	16.89
Waterfowl Hunting	26.58
Bank Fishing	3.14
Boat Fishing	35.79
Permanent Camping	29.33
Other Nonconsumptive	7.42

TABLE D-6-3

COMPARISON OF ATCHAFALAYA BASIN RECREATION VALUES

Activity	Value Per Day ($)	
	Bell	P&S
Big Game Hunting	40.78	10.50-17.90
Small Game Hunting	16.89	2.20-4.50
Waterfowl Hunting	26.58	2.20-4.50
Bank Fishing	3.14	2.20-4.50
Boat Fishing	35.79	2.20-4.50
Permanent Camping	29.33	1.50-4.50
Other Nonconsumptive	7.42	1.50-4.50

D.6.11. Tasks. Several tasks essential to the study were performed. These tasks were:

- The development of budgets for representative commercial fishermen and trappers in the basin
- The formulation of a bioeconomic model of the Atchafalaya Basin fisheries, which would be used to estimate the productivity of the fisheries, i.e., the ability to support and sustain a particular harvest (maximum sustainable yield or MSY)
- Estimation of demand curves for the products of the fishing and trapping industries
- The integration of the outputs derived from the above tasks to calculate the NED benefits of these industries

D.6.12. Data Sources. The two principal data sources utilized for this study were: "Atchafalaya Basin Usage Study," US Army Corps of Engineers, New Orleans District, 1975, and "Fishing Statistics of the United States, 1971-74," National Marine Fisheries, US Department of Commerce.

D.6.13. Methodology. The development of the budgets for commercial fishermen and trappers was accomplished by contacting key industry personnel in the Atchafalaya Basin region. Bell interviewed, by

telephone and in person, a representative sample of fishermen, processors, and marina operators to gather data for the budget estimates. Bell received significant support in construction of the commercial fishing budget from Dr. Ken Roberts, Fisheries Extension Economist, Louisiana State University, Center for Wetland Resources. For the commercial trapping industry, data sources were far more limited, and Bell's estimates of revenues and costs are based on limited contacts with fur processors and the sparse data that exists on this subject.

D.6.14. As for the estimation of maximum sustainable yield, Bell used procedures and modeling techniques that are standard in the fisheries economics literature. Historical data was used to estimate catch/effort relationships. Several alternative specifications of the catch/effort relationship were estimated and the reciprocal transformation yielded the best results for crawfish. Bell also attempted to ascertain the effects of water levels and temperatures on the crawfish harvest. These experiments yielded mixed results. The bioeconomic models for the principal Atchafalaya Basin species (crawfish, catfish and buffalo fish) were estimated, using data from the National Marine Fisheries series published by the US Department of Commerce. These data were also used to estimate the demand relationships for the principal species of fish.

ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA

FEASIBILITY STUDY

US Army Corps of Engineers
MISSISSIPPI RIVER COMMISSION
New Orleans District

JANUARY 1982

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APPENDIX E

SOCIAL AND CULTURAL RESOURCES

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Appendix E

SOCIAL AND CULTURAL RESOURCES

E.0.1. This appendix presents the social and cultural resources aspects of the project-affected area in two distinct parts. Part I, sections 1 and 2, presents the components of the Other Social Effects (OSE) account and addresses the respective impacts of each alternative upon those components which are significant to the study area.

E.0.2. Part II of this appendix, sections 3 through 12, consists of the study's cultural resource reconnaissance report. A cultural resource reconnaissance is defined as:

> A literature search and records review plus an on-the-ground surface examination of selected portions of the area to be affected, adequate to assess the general nature of the resources probably present and the probable impact of alternative plans under consideration. For archeological reconnaissance, test excavations may be required at some sites so that evaluations may be adequately accomplished. This level of investigation is appropriate to preliminary planning decisions and will be of assistance in determining viable alternative plans.

E.0.3. A reconnaissance level analysis was accomplished for the Atchafalaya Basin (Water and Land Resource), Louisiana, study based upon synthesis of previous archeological and ethnographic investigations in the basin. The main reference for this analysis was the draft report entitled, "Archeology and Ethnology on the Edges of the Atchafalaya Basin, South Central Louisiana: A Cultural Resources Survey of the Atchafalaya Protection Levees," prepared by the University of Southwestern Louisiana, under contract to the US Army Corps of Engineers, New Orleans, District (Gibson et al., 1980). Part II, sections 3, 4, 5, and 6 of this appendix are largely excerpted from the above referenced report.

E.0,4. Based upon existing data, significant cultural resource categories in the study area were defined. The effect of each alternative upon each significant resource was then assessed relative to the base condition and the projected future without-project condition. Finally, the future cultural resource requirements for the project, and the interpretive potential of the basin's cultural resources are discussed.

PART 1 - SOCIAL

Section 1 - SOCIAL RESOURCES

GENERAL

E.1.1. This section of the appendix presents the components of the Other Social Effects (OSE) account and discusses in general terms those components which are significant to the project area communities and/or those for which project-induced changes are of significance to the study area population. A detailed comparison of alternatives and their respective impacts follow this section.

COMPONENTS OF THE OSE ACCOUNT

E.1.2. The components of the OSE account include the following: urban and community factors; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation.

E.1.3. The principal features of urban and community characteristics are: income distribution, especially the share received by low income households; employment distribution, particularly with respect to minorities; population distribution and composition; the fiscal condition of the state and local governments; and, the quality of community life.

E.1.4. Life, health, and safety factors include such items as: risk of flood, drought, or other disaster; potential loss of life, property, and essential public services due to structural failure; and other environmental effects such as changes in air or water quality not reported in the National Economic Development (NED) or Environmental Quality (EQ) accounts.

E.1.5. Displacement includes the displacement of people, businesses, and farms.

E.1.6. Long-term productivity effects include maintenance and enhancement of the productivity of renewable resources, such as agricultural lands, for use by future generations.

E.1.7. Energy requirements and energy conservation include such items as use of nonrenewable energy resources during construction and operation of facilities, and conservation of nonrenewable resources.

SIGNIFICANT COMPONENTS

E.1.8. Those components of the OSE account containing features that are significant to the study area communities in and of themselves, and also with respect to the alternative plans under consideration are: the urban and community component; the life, health, and safety component; and long-term productivity. The displacement component of the OSE account is significant with respect to alternative plan impacts, but in general, displacement is not significantly more important to study area communities than nonstudy area communities. Energy-related factors included in the OSE account are not significantly more important in the study area as compared to communities in general, nor are any of the project features deemed to have significance with respect to this component.

E.1.9. Urban and Community. Of the principal features that compose the urban and community component of the OSE account, only quality of life as reflected by community cohesion has significance for study area communities in terms of plan alternative impacts as well as in a general sense irrespective of these impacts. The significance of community cohesion, apart from alternative impacts, lies in the unique cultural heritage of the Atchafalaya Basin with its associated ethnic groups and traditional lifestyles. Alternative plan impacts are significant because of the differential impacts on the fish-and-wildlife-supporting habitat that the traditional lifestyles depend on.

E.1.10. Noise is an aspect of the quality of life that is significant with respect to alternative impacts. Due to the semiwilderness nature of much of the study area, plan alternative increases in noise levels would be a significant impact.

E.1.11. There are other features of the urban and community component of the OSE account that would be of at least limited significance to study area communities as a result of plan alternative impacts. These are employment distribution and population distribution.

E.1.12. Employment distribution, in terms of shifts in the distribution of available employment opportunities, would be affected to some degree by alternative plan impacts.

E.1.13. Population distribution, with respect to geographic distribution and density, would be impacted in a limited manner to the degree that plan alternatives differ in their effects on community growth.

E.1.14. The fiscal condition of state and local governments would be impacted to a minor degree primarily as a result of differential plan alternative rates of forestland to cropland conversion and the associated potential changes in the tax base and tax revenues.

Section 2 - ALTERNATIVE PLAN IMPACTS

GENERAL

E.2.1. Social impacts likely to occur under the several alternatives analyzed are evaluated in this section. Nine major categories of impacts have been identified and the impact of each alternative is discussed in terms of effects in each of those categories. These categories are:

- o Community cohesion
- o Noise
- o Employment/Labor force
- o Community growth
- o Local government finance, tax revenue, and property values
- o Health, safety, and security of life
- o Emergency preparedness
- o Displacement of people
- o Displacement of farms.

E.2.2 Community Cohesion. The unique cultural heritage of the Atchafalaya Basin is in large measure linked directly to a way of life based on swamp resource exploitation. The preservation of this traditional lifestyle and the continued existence of some ethnic groups and folk society are dependent on preservation of the swamp habitat.

E.2.3. Under future without-project conditions, there would be a loss of the habitat necessary to provide the occupations that support the traditional lifestyle. The lower floodway would become drier and with the conversion of forestland to cropland, it would become increasingly more difficult to preserve traditional lifestyles.

E.2.4. The impacts of The National Economic Development (NED) plan are essentially the same as would occur under the without-project condition, except that the Avoca Island levee would benefit community cohesion in the backwater area. The Avoca Island levee extension would aid in preserving the existing community life and traditional lifestyles, which would be disrupted if rising water levels, such as

would occur under future without-project conditions, forced displacement of these communities.

E.2.5. The Environmental Quality (EQ) plan would reduce the drying-out process and subsequent agricultural development of the lower floodway compared to the future without-project conditions and would result in less loss of fishing and trapping habitat. This would help to preserve the traditional lifestyle of the area. There are, however, features of this plan that may unfavorably impact community cohesion. The public access to large areas of the lower floodways, made available by the environmental easements and recreation features of the plan, could possibly create a conflict between commercial and sport fishermen. Expanded activities by sport fishermen may be viewed as encroachment into the "territorial claims" of the commercial fishermen. Increased public access may also disrupt the traditional patterns and habits of the numerous private hunting clubs in the lower floodway.

E.2.6. The Tentatively Selected (TS) and recommended plans' impacts would be the same as those of the EQ plan.

E.2.7. Noise. The study area, because of the semiwilderness nature of much of it, is a relatively noise-free environment. Few areas, however, are totally noise-free. The activities of the oil and gas industry, water-based shipping industry, and sport and commerical fishermen occur throughout the area. Much of the noise that does occur is due to boat traffic originating with these groups. At times, even in the most remote parts of the basin, noise levels are high.

E.2.8. Under the future without-project condition, noise levels would temporarily rise during levee raising. Noise levels also would increase as agricultural and oil and gas development multiplies. Noise assoicated with recreational and commercial fishing would decrease.

E.2.9. Under the NED plan, noise would significantly increase above future without-project levels. This would be brought about by initial project construction activity as well as to the increased recreational usage and industrial and agricultural development that would follow the construction phase of this plan. Continuing expansion of agricultural and industrial development during the 2030 to 2080 period would continue to increase noise above future without-project levels.

E.2.10. The EQ plan would increase noise levels within the lower floodway and in the area south of Morgan City during the initial construction phase of the project. Following completion of initial construction, noise levels in the southernmost parts of the project-affected area would continue to be higher than in the future without-project condition due to the increased recreational usage of the area that would occur with this plan. In the northern parts of the

floodway, noise levels would probably be lower than under future without-project conditions, since the future without-project condition would include the noise associated with agricultural development. From 2030 to 2080, noise levels would continue to be higher than under future without-project conditions in the south of the floodway and lower in the northern portion of the lower floodway.

E.2.11. Noise levels with the TS and Recommended plans would not differ significantly from those of the EQ plan, except during the initial construction phase when they would be slightly higher in the areas south of Morgan City due to the dredging activities associated with channel training the lower Atchafalaya River and Wax Lake Outlet.

E.2.12. Employment/Labor Force. In the 19-parish economic study area, employment in 1970 was concentrated in trade, services, manufacturing, government, construction, agriculture, forestry, fisheries, and mining. Economic area employment was more concentrated in agriculture, forestry, fisheries, and mining in 1970 relative to comparable statewide data. About 24.1 percent of the economic area civilian labor force was employed in these industry sectors while the statewide average was about 15.6 percent.

E.2.13. Under future without-project conditions, there would be a minor increase in employment resulting from raising the east and west protection levees. There also would be some small increase in agricultural employment as forestland became converted to cropland as well as a small increase resulting from the development of water-based industry located on the higher grounds to the south of Krotz Springs. Commercial fishing employment would decrease because the habitat necessary for fish populations would be lost. There could also be a loss of jobs in the manufacturing sector if rising water levels in the backwater area force portions of the Morgan City industrial complex to relocate.

E.2.14. With the NED plan, there would be additional employment opportunities of a minor degree generated by construction of the various structural features of this plan. There would also be additional employment opportunities resulting from the increased visitation generated by the recreation development features of this plan. In the backwater area, the Avoca Island levee extension would help maintain existing employment opportunities, which could be lost due to abandonment of industrial and other commercial activities resulting under future without-project conditions. Within the lower floodway, impacts would be similar to the future without-project condition. There would be some small increase in agricultural employment as forestland was converted to cropland, and commercial fishing employment would decrease as the habitat necessary for fish populations would be lost; however, there would be no increase in employment resulting from the development of water-based industry due

to the NED's restriction on structural development.

E.2.15. With the EQ plan, additional employment opportunities generated by construction of structural features and increased visitations of the recreation development feature would be similar to the NED plan. The EQ plan, like the NED plan, would restrict the development of water-based industry in the lower floodway and preclude employment opportunities in this sector. However, unlike the NED plan, lower floodway environmental easements and management unit features of this plan would help maintain existing employment opportunities in commercial fishing and the timber industry, but would restrict potential opportunities in agriculture. In the backwater area, employment in the manufacturing sector would be threatened by rising water levels which might induce relocation. The threat associated with the EQ plan would not be as great as that with the future without-project condition.

E.2.16. The TS and Recommended plans' impacts would be the same as the EQ plan.

E.2.17. Community Growth. The potential for community growth exists in the Morgan City and vicinity area. This growth, the same as business and industrial growth, is directly linked to continued viability and expansion of the Morgan City oil- and gas-related industrial complex. Under future without-project conditions, rising water levels in the backwater area could adversely affect the expansion and even the existence of some facilities, thereby retarding the growth of the area.

E.2.18. Under the future without-project conditions, the most significant influence on community growth would be the negative effect resulting from rising stages in the backwater area.

E.2.19. Within the floodway, residential growth that might occur would be prevented with the NED plan due to restrictions on structural development. In the backwater area, the growth potential of those communities would be preserved due to absence of the higher flood hazard.

E.2.20. The EQ plan would be similar to the future without-project condition in the backwater area. The threat to the Morgan City industrial complex, however, would be somewhat less than the future without-project condition as some plan features act to limit the rise in stages and the corresponding flood hazard. Within the floodway, impacts would be the same as with the NED plan.

E.2.21. The TS and Recommended plans' impacts would be the same as those of the EQ plan.

E.2.22. Local Government Finance, Tax Revenue and Property Values.

The area of local government finance is concerned with items such as the tax base, property values, and tax revenues. Each of these, and other items, are important because they impact the financial condition of local governmental units. Financial soundness is important because it often determines the level and quality of the necessary public services provided by local governments.

E.2.23. Under the future without-project condition, there probably would be a slight increase in property values on forestland converted to cropland and a corresponding potential for increase in property tax revenue. The development of water-based industry in the lower floodway also could result in an increase in local property tax revenue due to these lands being assessed and taxed at a higher rate. On the other hand, rising water levels in the backwater area could force the relocation of industrial facilities and thereby reduce the tax base and tax revenues.

E.2.24. As a result of conversion of forestland to agricultural land and a possible expansion of other forms of development in the backwater area northeast of Morgan City, the NED plan could increase local property tax revenues due to these properties being assessed and taxed at a higher rate than would occur under future without-project conditions. Additionally, the recreational development features of this plan would increase use of the lower floodway, thereby generating increase in sales and other taxes. In the lower floodway there would be only a slight increase in the amount of forestland converted to cropland when compared to the future without-project condition. The difference in the effect on tax revenues would, therefore, also be slight. Restrictions on the construction of structures in the lower floodway would preclude the development of water-based industry and perhaps reduce the tax base and tax revenues as compared to the future without-project condition for this item.

E.2.25. With the EQ plan, impacts to industrial facilities in the backwater area would be similar to but less severe than the future without-project condition as rising water levels threaten relocation of the tax base. The environmental easements of this plan, however, would preclude agricultural expansion in the floodway and would prevent the generation of additional tax revenues above what would occur under future without-project conditions in that area. Impacts on tax revenues resulting from the recreation development features and restrictions precluding the development of water-based industry would be the same as the NED plan.

E.2.26. The TS and Recommended plans' impacts would be the same as those of the EQ plan.

E.2.27. Health, Safety, and Security of Life. In 1927, a huge flood devastated much of the lower Mississippi River Valley. As a result, Congress passed the Flood Control Act of 1928, authorizing the

Mississippi River and Tributaries project to provide for the safe passage of a project flood of 3 million cubic feet per second (cfs) at the latitude of Old River. Because of its early history as a natural floodway, the Atchafalaya Basin became an integral feature of that project with its natural features supplemented by man-made levees, a channel to assist in obtaining the floodway's assigned flood-carrying capacity of 1.5 million cfs, and two outlets for passing the flood waters out of the floodway system to the Gulf of Mexico. At present, the Atchafalaya Basin Floodway system is inadequate and can safely pass only 850,000 cfs, about 60 percent of its assigned capacity.

E.2.28. Under future without-project conditions, flood-carrying capacity would be maintained by raising the east and west protection levees. Levee raising would provide the capability of safely passing the design flood. However, rising water levels in the backwater area would produce adverse impacts to the residents of that area. The data that follow (Table E-2-1) show that there would be significant increases in the number of inundated residents for all frequency events.

E.2.29. The NED plan safely passes the design flood and prevents rising backwater area stages by extending the Avoca Island levee, thereby generating positive impacts.

E.2.30. EQ plan impacts would be the same as those of the NED plan with respect to safe passage of the design flood. However, water levels in the backwater area would increase and generate negative impacts but to a lesser degree than the future without-project condition.

E.2.31. The TS and Recommended plans' impacts would be the same as for the EQ plan.

E.2.32. Emergency Preparedness. As discussed under Health, Safety, and Security, the Atchafalaya floodway and levees comprise a vital part of the regional flood control system, thereby forming a major component of the region's emergency preparedness status. At present, the Atchafalaya Basin system is capable of handling only about 60 percent of its assigned capacity of 1.5 million cfs.

E.2.33. Under the future without-project condition, the floodway would be able to pass a major flood but delays in its use could be engendered by expanded development in the floodway.

E.2.34. NED plan impacts would be similar to the future without-project conditions. However, delays in floodway operation would be somewhat reduced when compared to future without-project conditions due to the restrictions on structural development.

E.2.35. With the EQ plan, the floodway would be able to pass major floods and restrictions of development would insure that few delays in putting it into operation would occur.

TABLE E-2-1

BACKWATER AREA POPLUATION INUNDATED
BY SELECTED FREQUENCY EVENTS

Existing Conditions (1980)

Event Frequency (Years)	Population
5	100
10	100
25	100
50	1,300
75	2,500
100	3,400

Without-Project Conditions (2030)

Event Frequency (Years)	Population [1/]
5	3,400
10	3,600
25	14,800
50	15,100
75	15,100
100	16,400

EQ, TS, and Recommended Plans (2030)

Event Frequency (Years)	Population [1/]
5	2,500
10	3,600
25	3,600
50	3,600
75	3,600
100	15,700

1/ Affected population in 2030 is based on existing population levels.

E.2.36. The TS and Recommended plans' impacts would be the same as for the EQ plan.

E.2.37. Displacement of People. Alternative plan impacts as they relate to the displacement of people are concerned with the direct and indirect consequences of plan implementation on areas of existing habitation. An example of a direct plan impact is displacement of persons forced to move because they inhabit lands required for project construction. An example of an indirect impact is displacement of individuals induced to move as a result of altered flood conditions caused by plan implementation. Under future without-project conditions, displacement of people would increase from both direct and indirect consequences.

E.2.38. Under the future without-project condition, displacement would occur adjacent to the existing levees as a result of levee raising, and possibly to residents of the backwater area who would experience increased flood hazards.

E.2.39. The NED plan would cause considerable displacement of people and consequent relocations. This would come about primarily due to raising of the east and west guide levees during the first part of project life. This work, which is partially complete and which would also occur under future without-project conditions, would impact hundreds of additional structures located primarily in the Henderson Lake and Courtableau areas. Many of these structures are residential and would involve relocation. Additional displacement of people could occur due to realinement of distributary channels and to widening the Wax Lake Outlet overbank area. It should be noted that this plan would prevent the displacement and relocation of people in the backwater area northeast of Morgan City, which could occur under future without-project conditions due to rising water levels in that area. As many as several thousand people could be benefited by the water level stabilization, which would be brought about by the Avoca Island levee.

E.2.40. The impacts of the EQ plan would be the same as those of the NED plan with respect to construction related displacements. Displacement in the backwater area, however, would be similar to the future without-project condition but not as severe.

E.2.41. The TS and Recommended plans' impacts would be the same as for the EQ plan.

E.2.42. Displacement of Farms. Displacement of farms refers to the forced abandonment of existing farms due to the completion of project features or conditions. Under future without-project conditions, some displacement of farms in the backwater area northeast of Morgan City would occur due to rising water levels associated with enlargement of the Atchafalaya delta.

E.2.43. Under future without-project condition, rising stages in the backwater area northeast of Morgan City would force approximately 10,000 acres of existing cropland out of production. It should be noted that because protection in the form of small levees and pumps will be feasible for some acres, the actual loss will be less than the estimated 10,000 acres which represents the worse-case situation.

E.2.44. The NED plan incorporates the Avoca Island levee extension, which would provide lower stages in the backwater area compared to future without-project conditions. This extension would help prevent approximately 10,000 acres currently used primarily for growing sugarcane from going out of production due to rising water levels in the future.

E.2.45. The impacts associated with the EQ, TS, and Recommended plans would be the same as the future without-project condition.

PART 2 - CULTURAL

Section 3 - ARCHEOLOGICAL INVESTIGATIONS

E.3.1. Possibly, the earliest report of archeological deposits in the Atchafalaya Basin was offered by the surveyor and cartographer William Darby. In his "Geographical Description of the State of Louisiana," he cites several "little mounts" 12 feet taller than the surrounding terrain along Bayou Fusillier (Darby, 1816). Soon thereafter, while appraising timber resources for naval stores, agent James Leander Cathcart described a shell midden near Morgan City "...which bounds an Indian burial ground, from whence they they frequently dig human bones, and once they found a whole skeleton..." (Pritchart et al., 1945). In 1847, an anonymous writer published, in DeBow's Review, his description of a mound and a shell midden along Bayou Pigeon, near Grand Lake. This site was said to be 100 yards in length and to contain human bones (Anonymous, 1847). The geologist and paleontologist John Wells Foster, whose observations on the archeological record of the time were published in a book, noted references to sites in the study area. In referring to a shell midden in the Grand Lake area, he remarked upon a stone ax and a pottery vessel found at that site (Foster, 1873).

E.3.2. During the last quarter of the nineteenth century, personnel of the US Army Corps of Engineers mapped the major drainage systems in the Atchafalaya Basin and on several maps, prepared under the direction of Major C. W. Howell, Indian mounds are demarcated. The sites are near Butte LaRose and along Bayou Sorrel (Howell, 1880-1881). The latter site is also shown on a map entitled, "Hardee's New Geographical, Historical and Statistical Official Map of Louisiana," dated 1895.

E.3.3. The first person to explore the Atchafalaya River with the expressed purpose of exploring archeological sites was Clarence Bloomfield Moore, of the Academy of Natural Sciences of Philadelphia. In 1912 and 1913, he visited and/or conducted tests at 12 sites in St. Landry, Pointe Coupee, Assumption, Iberville, St. Martin, and Iberia Parishes (Moore, 1913). High water at the time of his visit prevented large-scale excavations in the study area. It is notable, however, that "...16 skulls and a few bones..." collected from the Bayou Sorrel site comprise the first prehistoric, human skeletal material from Louisiana to be examined and the analyses published upon by a professional physical anthropologist (Hrdlicka, 1913).

E.3.4. Almost 25 years would pass before any other archeological investigations were conducted in the Atchafalaya Basin. Then in 1937, Fred B. Kniffen, a cultural geographer at Louisiana State University,

attempted to document all known sites in Iberville Parish. Through archival research and a field survey he located approximately 18 sites, some of which were in the limits of the present study area (Kniffen, 1938). His was the first attempt, and a most successful one, to note the physiographic implications of observable, archeological deposits in the basin. For one example, the lack of sites directly along the Atchafalaya River was attributed to the speculation that the main channel was too young to have been occupied by prehistoric population in this region. The same reason applies to the area just north of Grand Lake. Using mutually the evidence provided by rangia and unio shells, physiographic relationships and artifact collections, Kniffen (1938) was the first investigator to suggest a relative chronology for the archeological sites in the region under study.

E.3.5. From the 1930s to 1950s, archeological investigations in the Atchafalaya Basin proper were characterized by sporadic visits to previously recorded sites and documentation of a limited number of new sites. The only exception to this characterization is the work of William G. McIntire, a geomorphologist at Louisiana State University. During the 1950s, he visited and supplemented previous collections from known sites in the basin, as well as adding new sites to the record. McIntire's primary aim was to investigate the physiographic phenomena involved in changing stream patterns in the deltaic plain. With the realization that archeological data may be utilized to assist in understanding the history of geological events, he sought out and recorded data from a significant number of sites in the basin, particularly in the lower Atchafalaya region (McIntire, 1958).

E.3.6. In more recent history, several survey efforts within the study area have been conducted. In 1972, an archeological survey, which included parts of the present project area, was conducted on Bayou Boeuf and Bayou Black (Byrd, 1972). This study, performed under a Federal contract, produced an inventory of seven sites in the area.

E.3.7. Under US Army Corps of Engineers sponsorship, Louisiana State University (Neuman and Servello, 1976), conducted an extensive preliminary survey of a large portion of the Atchafalaya Basin in 1974-1976, though this did not include southern portions around Morgan City. A total of 133 archeological sites were recorded. Sites were classified by type and by cultural period; significance determinations and recommendations were made. However, the general utility of the survey was lessened by the absence of material cultural inventories and analyses and by the lack of any attempts at interpretation.

E.3.8. A cultural resources survey of the Gulf Intracoastal Waterway, which bisects the study area near Morgan City, was conducted by Coastal Environments, Inc., in 1975 (Gagliano, Weinstein, and Burden, 1975). This survey included a small part of the present project area.

E.3.9. The same firm and authors also prepared a report in 1978 on the proposed relocation route of US Highway 90, which included areas within the basin. Twenty-nine sites were located and assessed as to eligibility to the National Register of Historic Places.

E.3.10. In 1978, the University of Southwestern Louisiana conducted a survey of the lower Atchafalaya region in the parishes of Ascension, St. Mary, and Terrebonne under contract to the US Army Corps of Engineers, New Orleans District. The survey was limited to narrow linear corridors along Bayous Chene, Shaffer, Avoca Island Cutoff and, additionally, to an overland route along the Avoca Island Outlet channel. It was performed to provide a substantive basis for making recommendations for the avoidance of adverse impacts of planned construction on significant cultural resources. A total of 39 historic and prehistoric sites were found within project corridors.

E.3.11. An overview of the existing archeological data in the Atchafalaya Basin was prepared by Dr. Jon Gibson of the University of Southwestern Louisiana in 1979, under contract to the US Army Corps of Engineers (Gibson, 1979). Major archeological problems and suggested research strategies were offered.

E.3.12. The University of Southwestern Louisiana also conducted a survey, again under contract to the Corps of Engineers, of the East and West Atchafalaya Protection Levees in 1980 (Gibson et al., 1980). This survey was aimed at assessing the significance of cultural resources in the project corridors. Thirty-three sites were examined and 12 of these were judged to be significant and eligible for inclusion in the National Register of Historic Places.

E.3.13. In summary, archeological surveys in the Atchafalaya Basin have resulted in the discovery of hundreds of sites. To date, these surveys have been relatively few in the study area. Additionally, thorough on-the-ground search of certain localities is not a 100-percent sure method of discovering all or even most archeological sites. No evaluatory program has been tried that would yield the representativeness of the site sample compared with the number of sites (e.g., buried by alluviation, etc.) really present. Because many of the surveys were guided by aims other than the production of site distributional information, they have not resulted in archeologically useful data on siteless (or presumed siteless) areas, a necessity to analyses of spatial distributions. The site distribution pattern in the Atchafalaya Basin is a pattern produced by intensive efforts in a few corridors, preconceived assumptions by investigators, and the masking of the terrain by geomorphic activity. It is not a pattern that truly reflects the dispersion of archeological sites and should not be regarded as such.

Section 4 - PREHISTORY OVERVIEW

GENERAL

E.4.1. Over 250 prehistoric and historic archeological sites are recorded within the basin. This number is based upon review of site map files of the Louisiana Division of Archeology and Historic Preservation and files of the US Army Corps of Engineers, New Orleans District. The recorded prehistoric sites range from small midden deposits to large ceremonial mound centers.

E.4.2. The archeological sequence for southeastern Louisiana in which archeological manifestations exist is generally organized into six major units. A summary of these divisions is offered below. (Modified from Neuman, 1976.)

E.4.3. Paleo-Indian, 10,000 B.C. - 6,000 B.C. Diagnostic traits include bifacially chipped, lanceolate projectile points, both with and without flutes, extending up from a straight or concave base, along the longitudinal axis of the points.

E.4.4. Subsistence economy was based on hunting and gathering. Excavated sites reveal artifacts in association with terminal Pleistocene megafauna.

E.4.5. The settlement pattern revealed in archeological deposits generally consists of small temporary campsites near or along the edges of springs.

E.4.6. Archaic, 6,000 B.C. - c. 500 B.C. Diagnostic traits include a greatly expanded chipped stone and ground stone inventory, common throughout the Archaic, and includes medium to large-stemmed, triangular projectile points, side and end scrappers, perforators and drills, bifacial "knives", ground stone beads, celts, plummets, steatite vessels and effigies. Clay figurines and shell ornaments, an expanded bone industry that includes antler atlatl hooks and bone awls, a wide range of baked clay objects, and the importation of exotic raw stone material were added by the terminal Archaic Poverty Point culture group.

E.4.7. Subsistence economy consisted of hunting, gathering, and collecting, and there exists no physical evidence of a cultivated or domesticated food base.

E.4.8. Settlement pattern of this period includes large earthworks at the Poverty Point site, West Carroll Parish, comprised of a mound and concentric semi-circular ridges. A low-domed, earthern tumulus was tested on Avery Island; also, several campsite deposits of this

period were examined in the Lake Pontchartrain area. A series of seven, low earthen mounds built in a circular pattern is known as the Pickett Island site, Catahoula Parish. At the Monte Sano Site, East Baton Rouge Parish, excavations revealed remains of a structure having a square floor pattern. An earthen midden located on an inset terrace remnant is present to the west of the Atchafalaya Basin in St. Landry Parish.

E.4.9. Tchefuncte, c. 550 B.C. - A.D. 250. Diagnostic traits of this period include the first major introduction of pottery. Vessels are conical with multi-form, tetrapodal bases. Incised, brushed, punctated, and stamped decorative motifs appear on the vessel bodies and rim exteriors. A thick, red slip is present on some plain vessels. Decorated tubular, clay pipes are also introduced. Chipped and ground stone, bone and shell implements, and baked clay objects are common. These forms are similar to those of the terminal Archaic period but are generally less plentiful, variable, or ornate.

E.4.10. Subsistence economy during this period consisted of hunting, gathering, and collecting, with a probable trend toward broad-spectrum subsistence pursuits, which include a cultivated and possibly domesticated food base. Indications exist of horticulture from Tchefuncte deposits at the Mortin Shell Mound, Iberia Parish, and the Bayou Jasmine site, St. John the Baptist Parish.

E.4.11. Settlement patterns exhibited during this period consist of numerous sites in the marsh areas of southern Louisiana that are characterized as shell and organic middens. Inland sites most numerous along the prairie terrace to the west of the Atchafalaya Basin (Teche-Vermilion Watershed) principally consist of small, low, earthen mounds and middens. Gibson (1980) has confirmed Tchefuncte presence in the basin at several sites, including 16IV4 (Bayou Sorrel Mounds).

E.4.12. Marksville, A.D. 250 - A.D. 700. Diagnostic traits of this culture period are new pottery types comprised of bowls and globular, jar-shaped vessels that are elaborately decorated on the exterior with punctated, incised, and stamped motifs. Vessels may also be decorated with red pigment and stylized zoomorphic motifs. Ground stone and ceramic platform pipes and effigies are present. Artifacts of exotic raw materials, including copper, quartz crystals, asphaltum, and galena, are often present in sites of this period.

E.4.13. Subsistence economy of this period included broad-spectrum hunting and collecting augmented by a probable domesticated food base. Corn and squash are purported from the Marksville site, Avoyelles Parish.

E.4.14. Settlement pattern is somewhat varied; one extensive occupation, the Marksville site, consists of a group of earthen mounds

within a semi-circular, ridged, earthen wall. Domed mounds contain a central chamber for the disposal of the dead. Human interments, both primary and secondary, are deposited along with a selected quantity of pottery, chipped and ground stone, bone, shell, and copper funerary offerings. Other sites consist of middens and/or mounds with no visible evidence of palisades or enclosure. Evidence of a possible habitation structure, rectangular in plan with a semi-subterranean floor, was exposed at the Marksville site.

E.4.15. Troyville-Coles Creek, A.D. 700 A.D. - c. 1100. Diagnostic traits include the introduction of clay as a ceramic tempering agent, also the development of new decorative designs and vessel shapes is characteristic of this period. Simple incising on a wide variety of rims marks the earlier forms, while incising, punctating, and check-stamping become dominant later. This period is also marked by an expansion in bowl and platter (plate) vessel shapes. Elbow-shaped clay pipes, ear spools, and grinding stones become important features. Toward the end of this period, the preponderance of small, finely chipped projectile points probably indicated the introduction of the bow and arrow, whereas previously the atlatl predominated.

E.4.16. Based upon corn and squash agriculture, the subsistence pursuits were supplemented by broad-spectrum hunting and gathering.

E.4.17. The settlement pattern is characteristically, three large pyramidal, compound mounds oriented around an open plaza. Houses have either rectangular or oval floor patterns. Mounds of the Troyville site, Catahoula Parish, were within a large rectangular ditch (moat) and earthen enclosure. Multiple primary and secondary human interments, generally without artifactual associations, are common features in the mounds.

E.4.18. Plaquemine - Mississippian, A.D. 1100 - A.D. 1700. Diagnostic traits include new ceramic typologies, shell-tempered pottery, effigy vessels, new decorative motifs, strap handles, effigy pipes, and ear spools which characterize this period. Complicated stamped designs are presented during the earlier phases, with curvilinear design predominating later. Late in the period, native artifacts are found in association with European trade goods. "Southern Cult" artifacts are also present in some sites.

E.4.19. The subsistence economy was based on corn, bean, and squash agriculture supplemented by seasonal hunting and collecting.

E.4.20. The settlement pattern, consisting of large, compound, pyramidal mounds oriented around an open plaza, is characteristic of the larger sites. Mounds may have stepped ramps. Round, rectangular, or square structure floor patterns occur, with or without wall trenches. Some villages are surrounded by wooden palisades.

Secondary single and multiple-bundle burials occur in the mounds. Primary, flexed, human interments are also present.

E.4.21. The preceding categories are generalizations of cultures and types of sites to be found in the Atchafalaya Basin. The number of previous archeological investigations within and near the Atchafalaya Basin give the impression that the prehistory of the great swamp is well known. This is not the case. To describe the archeology of the basin requires the imposition of culture sequences that originated in regions outside the basin and the adoption of several corresponding assumptions about culture processes.

E.4.22. When Indians first moved into the Atchafalaya Basin is a matter of considerable conjecture.

E.4.23. No residues from Paleo-Indian activities are known within the present-day Atchafalaya Basin. Yet does this imply their absence or merely that the land surfaces that might have borne these evidences have been eliminated or buried by river channel shifts since Paleo-Indian times? Characteristic Paleo-Indian artifacts, mainly projectile points, have been found on Godeau Hill and Evergreen Island on the western edge of the modern Atchafalaya Basin. They seem to be associated with a relict, resculptured Mississippi River meander belt (i.e., the Lafayette-Mississippi meander belt), which has been entirely obliterated from the contemporary surface of the Atchafalaya Basin.

E.4.24. A similar conclusion can be reached concerning Archaic components. Although Archaic sites have been identified in the upper part of the basin, they all seem to lie along older, elevated landforms that have remained relatively untouched by subsequent degradation within the swamp itself. One such component is site number 16AV33. Superficially, 16AV33 appears to be connected with the Bayou Jack segment of the Teche-Mississippi course, which Saucier (1974) believes was active about 6000-4000 B.P. However, sediments and soils at the location hint of a far more complicated geomorphic picture, one that may have involved an ancestral meander belt of the Arkansas River. Archaic sites are densely scattered along the exposed natural levees of Big Darbonne Bayou, implying that the bayou was a significant water course during an earlier phase of its existence. Gagliano et al., (1978) suggests that Big Darbonne Bayou may have been a major crevasse.

E.4.25. South of US Highway 190, no Archaic sites have been identified from within the basin proper, although they do parallel the swamp margins atop the Mississippi alluvial valley walls themselves. In other words, they overlook the swamp but seemingly do not extend into it. This may seem somewhat unusual because the Teche-Mississippi River system, which apparently supports Archaic components in the

upper reaches of the Atchafalaya Basin, is well preserved to the vicinity of modern-day Berwick and Morgan City.

E.4.26. Until Gibson's (1980) survey of the East-West Atchafalaya Protection Levee, it was believed that Tchefuncte settlements were also missing in the Atchafalaya Basin. Now it is known that they do exist. They appear in high densities along the western edge of the basin flanking the Bayou Jack, Bayou Rouge, and Petite Prairie meander belts. From Bayou Courtableau (US Highway 190) south to Berwick, near the southern end of the swamp, the settlements seem to be more scattered but are present nonetheless. This survey, in fact, confirmed Tchefuncte components on the eastern flank of the Teche Ridge at Bayou Perronet (16SM50), Charenton Beach (16SMY2), and Mocassin (16SMY104). The Lake LaRose Mounds (Moore 1913), in the middle of the swamp about 7.5 miles southeast of Bayou Perronet, may also have a Tchefuncte component. On the eastern perimeter of the basin, Tchefuncte occupation may be present at Bayou Sorrel Mounds (16IV4) and the Schwings Place (Moore 1913). Both of these sites, however, appear to be positioned atop stable, elevated, remnant landforms, presumably formed by early Mississippi River alluviation, perhaps the Maringouin-Mississippi River. By normal archeological criteria, Poverty Point components are difficult to identify in many localities in south central Louisiana. This is probably a function of distance (200-250 miles) from the Poverty Point localities on the Macon Ridge in extreme northeastern Louisiana and western Mississippi, where typological details for culture unit attribution were originally extracted. Population enclaves in south central Louisiana, which were contemporary with the Poverty Point developments upvalley, were simply doing things in their own time-honored, traditional manner, which had proved adaptively successful for them and their ancestors. By stretching typological criteria and emphasizing the presence of exotic trade materials, it is, however, possible to ascribe some Atchafalaya edge components to the Poverty Point culture period. The Stelly mound group on Bayou Petite Prairie, near the Bayou Jack-Bayou Rouge meander complex (Teche-Mississippi meanders belt), seems to be a local center of activities during Poverty Point times. Farther down the valley escarpment in the vicinity of Lafayette, Louisiana, there is another cluster of sites, which temporally and, to an attenuated degree, culturally equate to the Poverty Point culture period. There are similar typological and interpretive problems in dealing with the Marksville, Coles Creek-Troyville and Plaquemine-Mississippian culture periods.

E.4.27. In short, very little is known about substantive prehistory in the Atchafalaya Basin and, in many cases, what is known is not based on findings from the basin proper but from outside regions, so distinctive from the swamp that applicability may be questioned. Almost every aspect of Atchafalaya prehistory is at issue, from chronological segmentation and culture unit systemization to simple descriptive and reconstructive categories dealing with settlement

subsistence, and higher-order levels of cultural interest. The state of understanding is so germinal and the technical problems with acquiring representative information so numerous that it cannot be claimed that the Atchafalaya Basin has contributed greatly to the explication of culture change, evolution, and historical events among native American population in the Lower Mississippi Valley.

E.4.28. One thing seems certain. The uniqueness of the region demands unique archeological perceptions and interpretations, and, therefore, great care must be exercised in determining the significance of sites and their disposition.

Section 5 - HISTORY OVERVIEW

GENERAL

E.5.1. Many of the 252 recorded archeological sites in the basin contain historic components. These include possible historic aboriginal remains as well as remains of European settlement in the basin. The considerable number of recorded ship disasters and Civil War-related vessel sinkings indicate the existence of subsurface or underwater ship remains. An overview of recorded history in the basin is provided in the following paragraphs. This overview is largely excerpted from Jon L. Gibson's and Robert B. Grambling's draft report (Gibson et al., 1980).

EFFECTS OF EUROPEAN CONTACT UPON NATIVE SETTLEMENT IN THE BASIN

E.5.2. The Atchafalaya Basin remained for a time off-limits to the terra firma-bound whites, and the few excursions into the swamp were confined to its higher borders. As a matter of fact, it was only after the native residents, the Chitimacha Indians, incurred the wrath of the French, following the assassination of the missionary St. Cosme in 1706, that French marauders, under St. Denis, dared to venture into the swamp's dark confines, and then only along the Fork of the Chitimacha (i.e., Bayou Lafourche) (Iberville in Brasseaux, 1979). However, one suspects that this incident was only an excuse to cover up the real reasons for the declaration of war on the Chitimacha; a more likely motivation being the desire to acquire Indian slaves.

E.5.3. The coming of first the French, then the Spanish, and finally the Americans furnishes several important considerations for the treatment of native settlement. First, it provided written documentation, though scant, of occupant groups and accorded tribal names to them, and it seems to have resulted in an upset of intertribal relations forcing tribal amalgamations, or extinctions, tribal shifts and migrations, and perhaps a general westward retreat across the basin, away from the white-controlled Mississippi River. It also introduced nonindigenous natives, displacing them from their original homes along the Mississippi River, into the lower and upper reaches of the basin. With these European-induced influences, swamp settlement patterns underwent change, ranging from almost negligible in some areas to extensive in others.

E.5.4. An initial effect was the nearly complete withdrawal of Indians from Bayou Lafourche, the so-called Fork of the Chitimacha, the eastern natural boundary of the Atchafalaya Basin. Early records (cf. Swanton, 1911) reveal that stretches along Bayou Lafourche were

occupied by the Chitimacha, the Washa, and the Chawasha. The latter two tribes, allies of the French and enemies of the Chitimacha (Swanton, 1911), seem to have merged, or at least become confused, and probably moved to the Mississippi River near New Orleans. After De Kerlerec's mention of them in 1758 (Swanton, 1911), they disappear from recorded history. The Lafourche also seems to have been vacated by the Chitimacha but their fate is unknown. It is possible that they joined or became the Chitimacha group encountered sometime later around Bayou Plaquemine, upstream from the Bayou Lafourche-Mississippi River confluence.

E.5.5. In 1882, Gatschet published the names of 15 Chitimacha villages, supposedly occupied around 1700; locations provided by an old Negro informant living on Grand Lake. Swanton (1911) acquired several more village locations from Benjamin Paul, last hereditary chief of the western Chitimacha in 1908-1909. Perusal of other documentary sources (Gibson, 1978) brings the total of known villages to about 30. Gibson (1978, 1980) has tentatively correlated five of the villages with known archeological sites or with locations of landtracts precisely delimited in conveyance records.

E.5.6. As previously intimated, the Lafourche Chitimacha may have moved northward to Bayou Plaquemine, or they may have simply moved across the Atchafalaya Basin and joined the western branch of the Chitimacha living on the lakes (particularly one called Lake of the Chitmachas, now Grand Lake) and along Bayou Teche.

E.5.7. Another circumstance of consequence to historic native settlement patterns in the Atchafalaya Basin concerns the apparent disappearance of at least two swamp tribes after the time of initial European contract. LaHarpe (in Conrad, 1971) mentions tribe, called Onquilouza, allied with the Washa and Chawasha, during his efforts to bring these tribes under French dominion in 1699. The Onquilouza are never mentioned again. The same literary fate befell another Atchafalaya tribe, variously referred to as Yagueneschito, Magenesito, Yagueneschito and Yaguenechitons (LaHarpe in Conrad, 1971; Iberville in Brasseaux, 1979). Like the Onquilouza, they were simply never mentioned after the Iberville and LaHarpe narratives were written. Swanton (1911) guesses that Yagueneschito might be a reference to the Attakpa and, if this is correct, the subsequent history of this group would have nothing further to do with the Atchafalaya Basin.

E.5.8. The beginning European colonization along the Mississippi River had other direct effects on native settlement in and near the Atchafalaya Basin. Nonindigenous tribes sought refuge in the poorly settled swamp and swamp margins. The Tunica (later amalgamated with the Biloxi) culminated a series of migrations from an original hearth in western Mississippi, opposite the mouth of the Arkansas River, by taking up residence at Coulee de Grues near Marksville, Louisiana, sometime during the latter part of the eighteenth century (Brain,

1977). This location, which actually falls in or very near the old homeland of the liquor-destroyed Vaoyels tribe, lies on the northern perimeter of the basin and is actually outside it.

E.5.9. The Lafourche delta country in Terrebonne Parish, on the southeastern edge of the Atchafalaya swamp, witnessed an influx of another Mississippi River tribe, the Houma. Throughout much of the European contact period, the Houma resided on the east bank of the Mississippi River in the Pointe Coupee vicinity. Following a series of epidemics and apparent foul experiences at the hands of the colonists, they migrated, Swanton (1911) says drifted, into the unoccupied swamps and marshes of Terrebonne Parish, where they live today. In route, they assimilated the decimated remnants of the Bayogoula and Acolopissa tribes, forming an ethnic amalgum. When they moved, or drifted, to this location is uncertain but by the first half of the nineteenth century, their presence in the Terrebonne area was noted (Swanton, 1911). The relocation of the Houma has interesting implications for settlement studies. While at their originial Mississippi location, the Houma were confirmed horticulturalists, resided in relatively large, sedentary villages, and seem to have had strong political and religious systems, and probably a rigid social heirarchy. After less than two centuries of occupation in the swamps and marshes, this group was transformed into hunters, trappers, and fishermen. Horticulture was largely forsaken. Settlement shifted from nucleated villages to extended linear communities along bayou banks. Seasonal extractive activities were adopted with all the evident consequences for year-round settlement instability. Tribal unity dissolved with the increasing autonomy of nuclear family units. The sense of tribalism faded, and today the Houma and their adopted brethern identify largely with being Indian rather than with being Houma (Stanton, 1979).

EARLY EUROPEAN SETTLEMENT PRIOR TO 1803

E.5.10. Early access to and within the basin depended entirely upon water transportation (Stoddard, 1812). There were two main routes across the basin prior to 1803 and both entered the swamp through Bayou Plaquemine, a Mississippi River distributary, on the eastern side of the basin. Passage through Bayou Plaquemine depended upon the level of the Mississippi River, and although the bayou was cleared and dredged in 1770, reliable passage through the basin was available only at high water until recent times (Comeaux, 1972; Robin, 1966). Smaller boats could, however, be tranported over land around the shallow entrance of Bayou Plaquemine. By 1805, a private portage service, complete with log rollers and mules, was operating on a sporadic basis (Prichard, Kniffen, and Brown, 1945).

E.5.11. Early settlement was limited to the periphery of the swamp and occurred entirely along the Teche Ridge. In 1765, Poste des Attakapas (St. Martinville) was established by several hundred Acadian refugees who arrived in Louisiana via Santo Domingo (Rushton, 1979). After Louisiana was ceded to Spain in 1766, a small Spanish settlement was established at New Iberia under the leadership on Don Francisco Bouligny in 1779 (Conrad, 1979). Although never substantial, immigration and settlement continued steadily throughout the Spanish period.

E.5.12. Many of the settlers in Louisiana prior to 1803 were refugees from Acadia (Nova Scotia) and the Creole French who were forced out of Santo Domingo during the slave rebellion (Rushton, 1979). Although some settled in the Teche region, most established themselves along the banks of the Mississippi River at New Orleans and upriver at the so-called Acadian Coast (Taylor, 1976). In 1803, Louisiana was returned to French control but only for 20 days as part of the political maneuver enabling Napoleon to sell the territory to the United States.

GROWTH OF THE PLANTATION SYSTEM, 1803-1861

E.5.13. Immigration began in earnest with the Louisiana Purchase. Between 1803 and 1810, the slave population doubled. Between 1810 and 1820, the entire population of the state doubled again (Rushton, 1979). Throughout the territorial period and early statehood (granted in 1812), population along the natural levees of Bayou Teche grew rapidly.

E.5.14. It was during the early days of the American period that agriculture became quite diversified, and cash crops grew in importance.

E.5.15. In 1819 when James Leander Cathcart undertook a survey of the timber resources of the Atchafalaya Basin, settlement was continuing on the high natural levees of Bayou Boeuf and Bayou Teche, and was beginning in interior sections of the basin, such as Bayou Plaquemine (Prichard, Kniffen, and Brown, 1945).

E.5.16. As settlement continued along the stream levees on the margins of the basin, the growth of commercial agriculture was stymied because of the lack of an effective means to get products to market (primarily New Orleans). The watery nature of the basin practically assured that the primary system of marketing transportation would make use of the natural transportation linkages, the waterways. Virtually all European and Euro-American travel in the basin up to that time had been by boat.

E.5.17. The steamboat, which enabled rapid, efficient, and economical means of water transportation, began to make significant inroads in the southern economy by the first few decades of the nineteenth century. Its impact on the Atchafalaya Basin was enormous and lasting.

E.5.18. Steamboats first reached the Atchafalaya Basin in 1819. The 103-ton Louisianais, constructed in New Orleans, was one of the first. It served primarily as a cattle ferryboat in the lower Atchafalaya Basin. By 1820, the Attakapas Steamboat Company operated the 295-ton Teche between New Iberia and New Orleans via the Gulf of Mexico (Brassaux, 1979). Following the demise of the Attakapas Steamboat Company, Captain Robert Curry brought his 48-ton Louisville through Bayou Plaquemine and the Atchafalaya Basin to Franklin in 1825 (Planter's Banner, 27 April 1848). Smaller steamers used Bayou Plaquemine (and later the improved Attakapas Canal) and the safer interior route to Bayou Teche during periods of high water. Since products were ready for market, steamer traffic took on a decided seasonal emphasis. Larger steamers were restricted to the gulf route, down the Mississippi River from New Orleans, then through the gulf and Atchafalaya River to Bayou Teche. Since the Teche was navigable to New Iberia year round by larger steamers, New Iberia soon became a major land center for water transportation.

E.5.19. Travel aboard antebellum steamboats was dangerous. Teche Valley pilots frequently whiled away their off-duty hours by drinking, and playing cards with the passengers in the bar. Fatigued and often inebriated, the pilots often steered their raft over dangerous shoals and snags. In fact, between 1825 and 1860, at least 19 vessels, 89 lives, and thousands of dollars in goods were lost along the Teche and in the Atchafalaya Basin as a result of mishaps. Oceangoing steamers were not much safer, as they were frequently top-heavy and easy prey to the violent thunderstorms for which the Gulf of Mexico is noted (Conrad, 1979).

E.5.20. Despite seasonal limitations and natural dangers, the steamboat provided the efficient and essential means of transportation from farm to market, which permitted the rapid development of the plantation systems along the margines of the Atchafalaya Basin.

THE PLANTATION SYSTEM IN THE ATCHAFALAYA BASIN

E.5.21. Growth of the plantation system in the Atchafalaya Basin resulted from the wedding of a socioeconomic system born in the southern states east of Louisiana with a locally successful crop, sugar. The familiar ideological bases and means for the plantation system spread westward with the emigration of English-speaking settlers.

E.5.22. Rivers provided the natural transportation and the steamboat was the work-horse for the system. The period of most accelerated development of the plantation system occurred between 1830-1860. Large plantations resulted in the diplacement of the small subsistence farmers and stock-raisers, particularly along the linear stretches of prime land, the natural levees of streams.

E.5.23. In other areas of the South, the plantation system developed around cotton. In southern Louisiana, including the Atchafalaya Basin, the system came to center on the production of sugar. Sugar had been produced on a limited basis in Louisiana since earliest colonial days, and throughout the eighteenth century, rum (tafia), produced from local sugar, was about the only distilled drink available. It was after 1800 that production of sugar became a serious enterprise. By 1835, the transition to sugar was virtually complete, and the sugar plantation began to develop as a social and economic way of life.

E.5.24. By the 1850s, the plantation society was in full bloom in the Atchafalaya Basin area (Sitterson, 1953). The wealthy planters evidenced lifestyles and value systems characteristic of the upper class everywhere, a lifestyle dominated by leisure and recreation, travel, and conspicuous consumption. Yet, with growth came attendant population pressure in settlements, because crowding was not solely an urban problem since most of a plantation workforce tended toward nuclear residence.

E.5.25. One by-product of these crowded conditions and lack of sanitation facilities was the ever-present threat of illness, which in the case of yellow fever and cholera, frequently reached epidemic proportions. In 1833, and again in the winter of 1848-1849, cholera ravaged southern Louisiana, killing thousands (Sitterson, 1953). While such epidemics were not common, cholera remained a problem until the beginning of the twentieth century.

E.5.26. Less common than cholera but more virulent, yellow fever made its appearance in the lower Atchafalaya in 1839, and after the Civil War in 1867 and 1878 (Conrad, 1979). Introduced into Louisiana in the 1790s from the Caribbean, yellow fever decimated nineteenth century urban populations in southern Louisiana. Unaware of the cause of the disease, or the fact that it was spread by the Aedes aegypt mosquito, nineteenth century treatment and preventive techniques did little to control its spread (Conrad, 1979). During the 1867 epidemic, the town of New Iberia, with a popultion of approximately 1,500, had almost 1,000 cases of yellow fever and over 100 deaths occurred (Conrad, 1979). Ironically, the steamboats, which made the plantation way of life feasible, were also responsible for the spread of cholera and yellow fever. The large-scale movement of human populations throughout the area hastened the spread of disease and increased the

probability of epidemics. While slaves were more commonly the victims of cholera because of crowding and poor sanitary conditions, the everpresent mosquito made no distinction among social classes. Thus, the period marked by the growth and decline of the plantation-dominated economy in the Atchafalaya Basin area was also noteworthy for loss of life due to illness and disease.

E.5.27. By the middle of the century not only was the Teche Ridge heavily settled, but the plantation system had also spread to the adjacent levees of Bayous Black and Boeuf and to the interior of the basin. The interior of the basin began to be settled as early as the 1840s around Bayou Chene (Comeaux, 1972).

E.5.28. Agriculture also began along Bayous Pigeon and Sorrel and the Grand River by 1845 (Planter's Banner, 17 June 1847). This area was developed primarily by absentee landlords and was heavily dependent on slave labor (Comeaux, 1972). A third area in the interior of the basin where plantation agriculture was practiced was along the natural levees of the Atchafalaya River north of Butte LaRose. This land was settled by 1818 (Darby, 1818), and most of the land spoken for by 1838 (Prichard, 1941). In addition to sugar, cotton was grown during this time period along Bayou Alabama (Comeaux, 1972).

E.5.29. In 1857, the New Orleans, Opelousas and Great Western Railroad was completed from Algiers, on the Mississippi River across from New Orleans, to the Atchafalaya River at Berwick Bay. The railroad, which took five years to complete, was to reorganize transportation and settlement in the basin and also sparked the development of what was to become the Atchafalaya Basin's major urban area, Brashear (later to become Morgan City).

E.5.30. With the completion of the railroad, regular steamboat service from Berwick Bay to Galveston was initiated by the New Orleans, Opelousas and Great Western Company in conjunction with Cornelius Vanderbilt, a national shipping magnate.

E.5.31. The town grew rapidly. Located along a crucial transportation route, its advantages quickly became apparent to would-be settlers. By 1859, there were 40 homes, a Catholic church, and a number of businesses in Brashear. In 1860, the town was officially recognized by the state legislature, and the community looked toward its first experience as a boom town, an experience which was to be delayed by the Civil War (the Morgan City Historical Society, 1960).

THE CIVIL WAR

E.5.32. The strategic importance of the Atchafalaya Basin after the fall of New Orleans and Baton Rouge to Federal forces in May of 1862

was due to Fort Hudson, a Confederate fortification on the Mississippi River north of Baton Rouge. Port Hudson was an obstacle to Federal control of the Mississippi River. Therefore, to open up the Mississippi River for Union troop movements, Union General W. P. Banks in 1862 proposed an alternative route around Port Hudson. This strategy involved driving the Confederate forces under General Taylor out of the Teche region to open routes through the basin and Bayou Teche up to the Mississippi River.

E.5.33. The primary Confederate defenses were constructed at Fort Bisland, straddling Bayou Teche near modern Calumet and Fort Burton on the western bank of the Atchafalaya River at Butte LaRose. In early April 1863, a combined naval and land Union force 18,000 strong attempted a pincer move on Fort Bisland. Heavily out-numbered, the Confederate troops under General Taylor abandoned Fort Bisland and retreated up Bayou Teche, hotly pursued by Banks. The Atchafalaya Basin was now controlled by Union forces and troop movements by water were unopposed. Upon reaching Alexandria, Banks reassessed his pursuit of General Taylor's forces and chose to mount an offensive on Port Hudson. Learning of Bank's troop redeployment and the weakening of Federal strength in Berwick Bay, Confederate General Taylor quickly devised a counter-attack to retake the area. Taylor's strategy to attack Brashear City was executed flawlessly, and the Union forces quickly surrendered on 23 June 1863.

E.5.34. After the fall of Port Hudson and Vicksburg to Union forces, the second Union invasion of the Louisiana bayou country began in September of 1863. General Taylor wisely withdrew his troops from Brashear City and employed hit-and-run strategy on the advancing Union troops. Unable to face Union troops in pitched battle, the constantly moving Confederate cavalry and patrols sniped, raided, and continually harassed the Federal troops.

E.5.35. This invasion, the Great Texas Overland Expedition, was turned back by the hit-and-run strategy of the Confederate forces, the indecisiveness of Union Commanders Banks and Franklin, and the pivotal Battle of Bayou Bourbeaux.

E.5.36. In March of 1864, Banks made on final attempt to push overland to Texas. The Union operation was three-pronged. Admiral Porter, with 19 gunboats and 10,000 men, under the command of General A. J. Smith, was advancing up the Red River. General Steele, with 12,000 men, was moving toward Banks from Camden, Arkansas. And Franklin, with 18,000 men, was advancing northward along the Teche Ridge (Evans, 1899).

E.5.37. Confederate General Taylor, who had been camped at Alexandria, moved on to Mansfield ahead of Porter's fleet. Porter captured Alexandria on 15 March. Steele' Arkansas force was

delayed. When Banks arrived in Alexandria, he linked with Smith's 10,000 men and moved on Mansfield. In the ensuing Battle of Mansfield, Taylor's Confederate forces, though out-numbered almost three to one, routed Banks and pursued him south through Alexandria (Evans, 1899). Leaving Alexandria in flames, Banks retreated down Red River road and escaped across the Atchafalaya River at Yellow Bayou. At the Atchafalaya River, Taylor stopped. Although the war would not end until the following summer, General Taylor was later to write (Taylor, 1879): "From the action of Yellow Bayou to the close of the war, not a gun was fired in the trans-Mississippi department."

RECONSTRUCTION AND ECONOMIC REORGANIZATION

E.5.38. The Civil War had several major impacts on the sugar plantation system. First, the war eliminated the primary source of labor, the slaves. With post-war emancipation, blacks who remained in the South had to be hired by planters. Gone forever was the forced, "free" labor under slavery, and the transition to a wage economic structure was neither smooth nor painless. Many a crop in the Lower Atchafalaya Basin was ruined by the breakdown of labor-management relations in the post-war years (Sitterson, 1953).

E.5.39. Another major blow to the sugar industry was the destruction of physical facilities during the three major Union campaigns along the Teche Ridge. Particularly destructive was Banks' first push up the Teche in the spring of 1863 (Raphael, 1975). Fences and buildings were used for firewood, livestock and supplies were consumed and, in many cases, homes and plantation facilities were subjected to destruction and other kinds of extreme vandalism.

E.5.40. A final serious consequence was the war-disrupted financing and marketing structures. Heavily in debt, with plantations in need of extensive repairs, credit destroyed and with little ready cash in hand or available from lending institutions, many formerly wealthy plantation owners faced extremely grim times (Sitterson, 1953).

E.5.41. Agriculture within the Atchafalaya Basin virtually ceased during the war (Comeaux, 1972). While the war disrupted agriculture in the basin, an event that was to have more far-reaching consequences was the clearing of the logjams blocking the Atchafalaya River. As early as 1816 (Darby, 1816) had commented upon the Atchafalaya River's potential for navigation, noting that the journey from the Gulf of Mexico to the Red River could be shortened by 127 miles if the Atchafalaya were rendered navigable. The logjams, or rafts, supposedly formed in 1778 (Darby, 1816) completely blocked the river (Blowe, 1820).

E.5.42. Clearing was begun in 1840 and completed in 1861 (Elliott,

1932). The immediate result was the rapid enlargement of the Atchafalaya River channel and increasingly severe flood in 1874 put an end to practically all commercial agriculture in the basin (Comeaux, 1972). The increased flooding was to become a prominant factor in bringing major cultural changes to the basin.

THE EMERGENCE OF AN EXTRACTIVE ECONOMY

E.5.43. Accelerated by war and post-war-related events, the Atchafalaya Basin witnessed the emergence of a unique form of nonagricultural, extractive economy. Several factors were responsible for this reorientation. Initially, the large pre-war landholdings along the broader, arable natural levees had forced the original small farmers and stock-raisers into less desirable locations along natural levees on the smaller waterways in the basin and in the marsh. With raft-clearing, these lowlands were more frequently and more extensively flooded. With less arable land available even for gardening and the disastrous effects of floods and backwaters on crops, swamp dwellers turned increasingly toward wild resources to supplement their garden foods. This trend continued, and many of the inhabitants turned completely to extractive pursuits. Some completely forsook the land and moved into houseboats. These floating houses, impervious to high water, could be moved as water and fishing conditions changed. Entire families could be located near the source of their economic activities without the attendent problems caused by flooding (Comeaux, 1972). Although many swamps and marsh dwellers continued to practice some subsistence farming, the extraction of wild resources had become a unique, full-fledged economic way of life in the Atchafalaya Basin. It centered on the seasonal exploitation of fish, crabs, crawfish, turtles, frogs, moss, and fur animals, in an annual round closely tied to changing water levels in the swamp and other ecological conditions (Comeaux, 1972; Begnaud and Gobson, 1975).

E.5.44. While some of the swamp exploiters spoke English (primarily around Bayous Chene and Sorrel), most spoke French. The French-speaking Acadians were among the earliest Euro-American settlers of the area and, consequently, were among the first dislocated by the expansion of the plantation system. These Canadian exiles, whose lifestyles came to be molded by adaption to south Louisiana environments, became a distinctive culture group--the Cajuns. Although eight distinct ethnic groups are now located in the basin and all share a rather homogenous set of adaptive strategies pertaining to swamp exploitation, the Cajuns have had the greatest sustained cultural influence.

CAJUNISM

E.5.45. Previous attempts to define Cajunism have utilized several different conceptual approaches. First, and perhaps most commonly, Cajunism has been defined normatively--what Cajuns do or are expected to do (Keating, 1966; King, 1970; Ketchum, 1973; DelSesto, 1975), or attitudinally--what Cajuns think or believe (Harris and Gramling, 1978; Ribon, 1966). While some minor differences are expressed by these authors, they are agreed on the point that "Cajunism" is reflected in values associated with "laissez le bon temps rouler" (translated, "let the good times roll").

E.5.46. Another approach toward delineating Cajunism might be called cultural history, or historical induction (Conrad, 1978; Rushton, 1979). Under this approach, the elements of Cajunism are traced historically to their cultural roots, and general and specific contributors and contributions to Cajunism are isolated. Specifics may be debated, but common to all cultural historical definitions of Cajunism are: exiles from Nova Scotia (Acadia); French language and culture; assimilation of some African culture traits; isolationism in Louisiana; Catholic religion; and physical environmental influences.

E.5.47. Finally, a more general approach has been used in which the primary criterion for Cajunism, or any ethnic group for that matter, is considered to be ascription and self-description (Barth, 1969). Quite simply, Cajuns are those people who identify themselves as Cajuns and are so identified by others (Tentchoff, 1975). While possibly quite accurate, this approach allows for little differentiation by outsiders.

E.5.48. Although Acadians were among the earliest settlers along the natural levees in and around the basin, their supremecy as land holders was temporary. Following the Louisiana Purchase in 1803, migration from the former British colonies into Louisiana increased tremendously. These English-speaking settlers, perhaps more ambitious and certainly wealthier than their Acadian counterparts, were looking to establish a cash-crop agriculture, and they brought with them the plantation system, complete with slaves. Less competitive than their English contemporaries, the Acadians soon sold the best land along the major bayous and retreated to the natural levees of smaller bayous and into the swamp.

E.5.49. There were many reasons why the Acadians sold their good land and moved into the swamp. First, they could not afford to build and maintain the levees and roads that were required by law for all front holders. Second, they feared debt and once in debt, they sold their land. And third, these poor, independent Acadians were considered to be a bad influence on the plantation slaves, and plantation owners were willing to buy their frontage at almost any price. The main result of the aggressiveness of the Anglo-Americans was the

abandonment of such areas as the upper Bayou Lafourche by small independent farmers and their replacement by large sugar-producing plantations employing Negro labor (Comeaux, 1972).

E.5.50. Once in the swamp, gradual changes in economic practices occurred. Forced to poorer lands, the emerging Cajuns, originally subsistence farmers, turned evermore toward extraction of the swamp and marsh resources to supplement agriculture. Additional pressure for agricultural lands, and increased flooding of existing lands caused by the removal of the rafts in the Atchafalaya River, made the slow transition from agriculture to an almost entirely extractive economy inevitable. At the same time that a plantation economy was developing and flourishing along the major natural levees, a unique extractive economy was emerging in the Atchafalaya Basin and marshes of South Louisiana, associated with working class statuses. This began a physical isolation of the working class Catholic peoples in South Louisiana.

E.5.51. Buffered by linguistic barriers, the Cajun culture developed, centered on Catholic working class norms, but influenced, to be sure, by French heritage, Acadian experience, and the resources available in the environment. Cultural continuity was bolstered by the fact that mobility out of the culture required drastic individual change. Social mobility into another socioeconomic class requires that the individual adopt the values of the class to which that individual aspires (Merton and Kit, 1950).

E.5.52. Upward mobility for the Cajun generally required physical and linguistic change, since there were few if any middle class jobs in the extractive economy and middle and upper class occupations were dominated by English-speaking people. Many an individual of Acadian descent did just that and moved into Creole culture.

LUMBERING IN THE BASIN

E.5.53. One swamp resource that was not part of the extractive economic complex (presumably since it required relatively large capital outlays) was logging. Although timber was removed from the Atchafalaya Basin as early as the first half of the eighteenth century, its real commercial importance was not realized until after the Civil War. Cypress (Taxodium distichum) was by far the most valuable species available for exploitation.

E.5.54. The logging technique in use from the early 1700s to the 1880s took advantage of the rise and fall of the river. Trees were ringed or "deadened" in the fall. In the early spring the dead trees were cut. As the water rose, the logs floated from where they were felled and then were towed downstream to markets.

E.5.55. By an Act of Congress in 1849, the United States Government granted to the State of Louisiana all of the overflow and swamplands within the state that were unfit for cultivation (US Congress, 1849). The state accepted these lands in 1850, and much of the land was soon transferred to individuals having political influence (Norgress, 1947). While the Civil War slowed exploitation of the timber, the Congressional Timber Act of 1876 allowed the sale of most of the remaining land for as little as 12.5 cents per acre. With the swamp now open to exploitation, improvements and innovations in the cypress lumber industry soon followed. Principal among these improvements was the overhead skidder and pullboat. The overhead skidder utilized a cable suspended between two tall poles or trees. This allowed a steam winch to drag logs out of the swamp from distances of up to 1,000 feet. The pullboat was simply a barge with a steam-operated winch that could pull logs from 3,000 feet away into the canal in which the pullboat operated. Later, skidding the logs to a railroad was developed as a more flexible way to logging (Norgress, 1947). Beginning in the 1880s and continuing through the 1920s, cypress was removed from the Atchafalaya Basin at a phenominal pace. The introduction of the circular saw and, later, and more importantly, the band saw allowed the timber to be processed at ever-increasing rates. Saw mills and shingle mills developed along the Teche and at Morgan City (Norgress, 1947). Cypress was used for much of the contemporary construction, and today many of the older houses and barns in southwest Louisiana that date back to the turn of the twentieth century are built of cypress. Additionally, cypress shingles were shipped to the north and eastern United States and for a while were so plentiful that they sold for less than pine of a similar grade (Norgress, 1947). By 1925, the cypress was practically exhausted and the industry almost dead. The once great cypress swamps were cut out. An era had come and gone, and the esthetic and ecological character of the basin had undergone drastic revision. The lumbering years in the basin contributed much to the folklore and legends of the swamp. The swampers, who lived much of the year in camps constructed on rafts of great cypress logs, were much memorialized, if not actually envied (Coulon, 1888). Hand-hewing trees up to 6 feet in diameter from raised platforms was a difficult and dangerous occupation, and like most jobs that bear an element of danger, swamping carried a respected status.

THE GROWTH OF URBAN CENTERS IN THE BASIN

E.5.56. On the eve of the Civil War in 1860, Brashear City was recognized by the state legislature. Described in 1863 as "a miserable dirty village of a dozen houses," it was not exactly a metropolitan dream (Edmonds, 1979). With the close of the war, however, the strategic location of Brashear City began to play a crucial part in the economic reorganization of the area. It was

located on the Lower Atchafalaya River, which connected all parts of the basin with the Gulf of Mexico. It also was linked to New Orleans by rail. This transportation network soon attracted outside attention, namely from Charles Morgan, a New York shipping and rail magnate. Morgan purchased the New Orleans, Opelousas, and Great Western Railroad in 1869 and operated it in conjunction with steamer lines connecting Brashear City with the Sabine River and Galveston. Its new-found role as a major terminal in east-west ship and rail traffic brought great prosperity to the town, and its grateful citizens renamed it Morgan City in honor of its benefactor.

E.5.57. In addition to improving the rail link between New Orleans and Morgan City, Morgan was also successful in dredging a channel through the mud flats and oyster reefs in Atchafalaya Bay. The channel, completed in 1847, was 10 feet deep, 200 feet wide, and approximately 6 miles long (the Morgan City historical Society, 1960). The completion of this channel permitted Morgan's steamers ingress and egress to the Gulf of Mexico, regardless of tidal or river conditions.

E.5.58. By 1880, rail links between Berwick and Vermilionville (Lafayette) were completed, and in 1882, a railroad bridge across the Atchafalaya River completed the rail connection between New Orleans and Vermilionville. With the initiation of regular rail service, the steamboats gradually began to lose their competitive edge. More reliable, faster, and safer, trains were the prime factor in the demise of the steamboats. By the 1880s, a great deal of diversification had occurred in the urban areas within and contiguous to the Atchafalaya Basin. Formerly, almost totally dependent on agricultural products and related services, basin towns--especially Morgan City--were now serving as collection and distribution centers for agricultural products, lumber, fish and seafood, moss, pelts, and waterfowl. The extractive economy that had developed in the basin funneled its products through Morgan City to New Orleans. The growth of the oyster industry was indicative of the area's potential, and was closely paralleled by increases in other economic pursuits.

E.5.59. Morgan City became a boom town, and experienced all the growing pains generally associated with rapid expansion. Seafood, freshwater fish, and lumber continued as the mainstays in the Atchafalaya Basin through the turn of the century and well into the 1930s. Once the regular steamboat traffic ceased, siltation became a continuing problem, especially in the channel through Atchafalaya Bay. Lack of a deepwater channel discouraged Morgan City's attempt to become a major port, although some shipbuilding and repair services were in existence during this time. A major boost occurred for the shrimp industry in 1937, when Captain Theodore Anderson unloaded the area's first load of offshore jumbo shrimp at the Riverside Seafood Market in Morgan City. Shrimping prior to this time had been limited to shallow water and inland bays. Rapid growth of the shrimping

industry occurred thereafter, and by 1940, Morgan City was claiming the title of Shrimp Capital of the World. The channel through Atchafalaya Bay was redredged during the winter of 1939-1940, largely because of increased traffic from shrimping activities and local political pressure (The Morgan City Historical Society, 1960). By 1940, with the lumber industry on the decline, the shrimp and seafood industries were booming, and sugar production was once again on the rise. Trapping in the coastal marsh was also reaching its peak. However, other events of the time were to have major consequences on the Atchafalaya Basin.

PETROLEUM PRODUCTION AND MODERN EVENTS IN THE BASIN

E.5.60. Oil was discovered. Actually, the first oil well had been drilled on Belle Isle, a salt dome in St. Mary Parish, in 1896. The try was unsuccessful. However, 39 years and 72 dry holes later, Herton Oil Company completed an oil well in the Jeanerette area. Exploration in the basin interior was underway by 1928 and by 1940, widespread seismographic and drilling activities were being conducted throughout the basin and in the coastal marsh south of the Teche Ridge (The Morgan City Historical Society, 1960).

E.5.61. Like the early lumbering operations, petroleum-related activities altered the natural environment. Where the land is at or only a few feet above sea level, as it is throughout much of the Atchafalaya Basin, the simplest means of getting drilling and production equipment to well and tank sites was by barge through canals dug specifically for that purpose. Additionally, connective pipelines had to be installed and other canals were required to facilitate their construction. Today the Atchafalaya Basin and the marshes below Morgan City and honeycombed with canals.

E.5.62. In 1946, Magnolia Petroleum Company put down an exploratory well near Eugene Island, off the Louisiana coast, south and east of the mouth of the Atchafalaya River. The well was a failure, but an important precedent was set. Offshore drilling was born in the Louisiana gulf. Kerr-McGee soon followed and brought in the first producing offshore well in 1947 (the Morgan City Historical Society, 1960). The race was on, and offshore oil-related industries soon became the dominant economic activity in the lower Atchafalaya Basin. The shift to petroleum-related activities has brought considerable change to the basin. Dramatic increases in the population of urban areas and drastic shifts in land use, especially long water fronts, are two of the more visible changes (Stallings, et al., 1977). The economy of the urban centers in the lower Atchafalaya Basin has become "...highly dependent on offshore petroleum and gas activities" (Manual, 1977). Unable to compete for dock space with oil companies, the once large shrimp fleet was considerably diminished

(Grambling and Joubert, 1977). The extractive economic pursuits of the basin interior, so important in the early development of Morgan City, now funnel their products through the dozens of small towns that have sprung up along the Atchafalaya protection levees. The conversion of the Atchafalaya Basin into the Atchafalaya Floodway after the 1927 flood expelled the basin's residents. These hunters, trappers, fishermen, and crawfishermen moved to levee settlements or larger nearby towns. However, this migration did not hurt the extractive economy of the basin. In fact, concurrent technological advances especially the outboard motor and the planing hull bateaux have, if anything, increased access to the prime resource grounds in the basin. Recreational use of the basin has also increased at a rapid rate.

E.5.63. Today the Atchafalaya Basin is largely devoid of human habitation. Yet utilization for livelihood and recreation is greater than at any other time in its cultural history. In the 300 years of Euro-American settlement and use, the Atchafalaya Basin has undergone sweeping changes. In fact, the enormous siltation that has occurred since its transformation into a floodway, the primary release valve for Mississippi flood waters, threatens to bring even more drastic changes. The next few decades will be a critical time in the cultural and natural history of the Atchafalaya Basin.

Section 6 - BASIN CULTURE

GENERAL

E.6.1. Included in the cultural resources survey of the Atchafalaya Basin protection levees was an ehtnographic survey designed to identify and describe ethnic groups, culturally distinct lifeways, and folk cultures in the basin that may be affected by the ongoing levee enlargements. This survey was not restricted to the levee corridors but included the settlements of Henderson, Catahoula, Coteau Holmes, Bayou Benoit, Livonia, Maringouin, Pierre Part, Bayou Sorrel, Bell River, Bayou Pigeon, Plaquemine, Sherburne, Amelia, Charenton, Krotz Springs, Musson, and Bloody Bayou.

E.6.2. This requirement was included because the Corps recognized that the unique folk culture in the basin deserved further study and consideration in the planning process of the Atchafalaya Basin, Louisiana, study. The results of this survey, largely excerpted from the draft survey report by Charles Ray Brassieur (Gibson et al., 1980), are presented in the following paragraphs.

FIELD METHODS

E.6.3. The communities were canvassed during a 17-day period from 11 September to 11 October 1979. The ethnographic team was composed of two and sometimes three people under the specific direction of Charles Ray Brassieur, under the general guidance of the project principal investigator, Jon Gibson.

E.6.4. Time was a limiting factor for this investigation. Therefore, data acquisition methods had to be adjusted accordingly. Informal interview, observation, and participant observation became the principal means of investigation. Time constraints also obliged the ethnographic team to target a select informant population rather than one predicated on more desirable statistical sampling procedures. Public officials and community leaders, e.g., town officers, religious leaders, owners and managers of business establishments, and other public servants, were identified as the most likely sources of information about varied aspects of the communities. These were sources that, because of their leadership roles, might be more willing to discuss their communities than the average person, who probably could not have been found in the time allotted to each town. Thus, in a sense, the information is nonrandom, or biased. This probably has more serious consequences for quantitative, rather than qualitative, dimensions, but the latter cannot be disallowed because of the possible social distances between the levels of community

hierarchies. The Atchafalaya ethnographic survey must be regarded as a highly preliminary statement, only a beginning toward the exposition of an Atchafalaya ethnography.

IDENTIFICATION AND DESCRIPTION OF ETHNIC GROUPS

E.6.5. Simple identification and description of ethnic groups in the Atchafalaya region is no small task. George A. DeVos (1972) suggested that precise definitional qualities common to all ethnic groups are virtually impossible to obtain. After more than a decade devoted to ethnic matters, James H. Dorman (1980) reported that "the absence of conceptual and definitional clarity is the central problem in ethnic studies today."

E.6.6. When the term "ethnic group" was first defined in the Dictionary of Social Sciences, in 1964, the emphasis was on shared cultural traits. Melvin Tumin, who supplied the entry (Tumin, 1964), defined an ethnic group as: "...a social group which, within a larger cultural and social system, claims or is accorded special status in terms of a complex of traits (ethnic traits) which it exhibits or is believed to exhibit." Together with shared cultural traits, an accepted definitional quality of ethnic groups pertained to common historical origin. William S. Bernard (1972) stated:

> ...ethnic groups are people who have been brought up together under a particular cultural roof. They share the same ways of doing things, the same beliefs and institutions, the same language and historical background.

Using these definitional criteria, ethnic studies generally proceed by examining outwardly manifested, objectively perceived cultural criteria.

E.6.7. In 1969, however, a volume edited by Fredrik Barth, entitled Ethnic Groups and Boundaries, revolutionized the concept of ethnicity and ethnic groups. In the introduction to this volume, Barth (1969a) insisted that the "cultural roof," formerly of principal importance in the analysis of ethnic phenomena, was not a primary and definitional characteristic of ethnic groups. To the contrary, Barth (1969a) argued that:

> The nature of continuity of ethnic units is clear: it depends on the maintenance of a boundary. The cultural features that signal the boundary may change, and the cultural characteristics of the members may likewise be transformed, indeed, even the organizational form

> of the group may change--yet the fact of continuing dichotomization between members and outsiders allows us to specify the nature of continuity, and investigate the changing cultural form and contents.

Barth's statement shifted analytical focus from the inconsistent and situational cultural content of the group to the social boundaries that separate them.

E.6.8. But if the entire range of cultural content is not important to group maintenance and if the cultural features that signal its boundary may change, how is the ethnographer to recognize meaningful boundary markers? Because in Barth's model, self-identification is the critical criterion of ethnic identity (Barth, 1969), these boundary markers are perceived and agreed upon by members of the ethnic group. The ethnographer, then, is directed to a study of boundary markers subjectively defined by members of the ethnic group. Apparently, no amount of empirical observation from an etic perspective will illuminate these parameters so they are consequential only in the emic perceptions of an ethnic group's members.

E.6.9. Factors leading to the situational nature of these subjectively established boundary markers, according to Barth, pertain to intergroup competition for scarce resources (Barth, 1969). Actually, this concept was existent before Barth's Ethnic Groups and Boundaries. Beyond the Melting Pot (Glazer and Moynihan, 1963) explored the manner in which ethnic groups function as common interest groups by constantly changing and reorganizing their structures to meet challenges posed by other groups. John Paden (1966), taking this argument a step farther, discussed changes in ethnic identity from one social encounter to another (Hicks, 1977). Throughout the 1970's, ethnic investigators repeatedly pointed to the dynamic situational nature of ethnic groups in conflict and competition with other groups (Nagata, 1974; Despress, 1975; Patterson, 1975; Schiller, 1977). These findings commonly implied that ethnic group formation was accomplished by instrumental choices of members as they evaluated their material well being. As Dorman (1980) has pointed out, this is the ultimate statement of the subjectivist viewpoint. Ethnicity is reduced to an exlusively circumstantial phenomena.

E.6.10. Reacting to Barthian subjectivism, Wsevolod Isajiw (1974) insisted that ethnic group membership is involuntary. The link between ethnic group continuity and the socialization process, according to Isajiw, requires common historical origin among members of the same ethnic group. A person is born into an ethnic group and socialized into the special cultural traits of that group. No choice is involved.

E.6.11. The preceding summary of theoretical issues illustrates some of the ambiguities in the field of ethnic studies. There are no precise, widely accepted cirteria by which to differentiate ethnic groups; indeed, there is no generally acknowledge definition applicable to all groupings of ethnicity. Ethnographers choose between one of two polarized conceptual stances, the subjectivist, or the objectivist view; or alternatively (van den Berghe, 1975); (DeVois, 1975), select some form of eclectic compromise between the two viewpoints. The Atchafalaya ethnic data will be viewed from both perspectives.

E.6.12. The following part of this section is structured around Isajiw's (1974) breakdown of the five most common features used by students of culture in defining ethnic groups: common ancestral origin, language, race, religion, and same culture or customs. As Barth suggests (1969a), these cultural attributes are differentially pertinent to the question of ethnicity, depending upon the particular ethnic group involved. Informant commentary, observations made by field personnel, and supplementation from existing literature supply the base data for this study.

ETHNICITY AND COMMON ANCESTRAL ORIGIN

E.6.13. A discussion of ancestral origin is a good place to begin analysis of ethnic groups, if for no other reason than the historical perspective it offers. The one identifiable group with longest historical ties to the Atchafalaya Basin is the Chitimacha Indian tribe. The original tribal territory was a triangular trace of land subsuming the middle and lower Atchafalaya Basin. No groups of Indians, other than the Chitimacha, remain in the Atchafalaya Basin proper today.

E.6.14. The Chitimacha became wards of the Department of the Interior Bureau of Indian Affairs in 1925, when they were accorded reservation status and 283 acres of land in the Charenton community (Gregory, 1979). Since that time, a newly constructed school, tribal center, museum and park facilities, and government stipends, have been established to entice the Chitimacha to maintain residence within reservation boundaries.

E.6.15. Until the twentieth century, Chitimacha society was organized into matrilineal clans (Stouff, 1974). The leaders of each clan and their families were considered nobles, while the bulk of the people were accorded the status of commoners (Swanton, 1911). This rank system, unlike the Natchezean system (Brain, 1971) was perpetuated by class endogamy. Long-lived noble lineages developed and were maintained for hundreds of years. Ancestral origin was, in pre-twentieth century Chitimacha society, essential to ethnic identity.

E.6.16. By the 1930's, Chitimacha chiefs, like Benjamin Paul, came to be selected more out of respect than because of heritage (Gregory, 1979). Many of the rigid class distinctions deteriorated during the twentieth century, and, when the last traditional chief, Emile Stouff, died in 1978, practically all vestiges of traditional social hierarchy died with him. Before his death, Stouff had instituted a change from a chieftan form of leadership to a governing tribal council headed by an elected chairperson. Today relatively few Chitimacha are familiar with the original clan and caste system (Faye Stouff; personal communication, 3 October 1979).

E.6.17. As Gregory points out (1979) the family continues to perpetuate Chitimachan identity. The Chitimacha are organized into large extended family groups, not unlike that of the extended Creole or Acadian family. The change in social system that occurred during the twentieth century has not diminished the importance of ancestral origin as a primary marker of ethnic identity. Ancestral ties with the native, aboriginal inhabitants of the Atchafalaya Basin area continue to distinguish the Chitimacha from other regional, ethnic groups.

E.6.18. Perhaps the most important immigrants to enter the basin (if not in size, then certainly in sustained cultural influence) were the refugees expelled from Acadia by the English in 1755. These Acadians came to Louisiana in two major pulses; about 2,400 arrived from Acadia, the English Atlantic Seaboard Colonies, and Saint-Domonique between 1759 and 1776, and another 1,600 came from France in 1785 (LeBlanc, 1979). Inasmuch as the Acadians chose to gather from various corners of the western hemisphere and locate on Louisiana soil during the last half of the eighteenth century, it must be assumed that ancestral origin was indeed a powerful factor influencing ethnic identity and continuity. Conrad (1978a) argues that the Acadian reunion in Louisiana can best be explained by a strong desire to perpetuate a cultural identity developed in Acadia. These strong ties with a remembered ancestral origin are particularly interesting when one considers that three-quarters of the immigrants who arrived in 1785 had never been in Acadia (LeBlanc, 1966).

E.6.19. Upon arrival in Louisiana, some Acadians settled above New Orleans adjacent to the German settlements while others located at the newly established District of the Attakapas on Bayou Teche (Conrad, 1978b). As the plantation system expanded early in the nineteenth century and wealthy Americans poured into the newly acquired United States territory, the Acadians (as well as many of the Spanish speakers) were pushed even further away from the prime natural levees. Not able, or perhaps not willing (Reilly, 1978) to compete with the ambitious Anglo-Americans, the Acadians retreated to the swamp where they began to develop the skills, technology, and know-how necessary to exploit a new environment.

E.6.20. The peoples who adapted to the swamp during the nineteenth century were not of a single national origin. The Gallic persuasion that dominated the acculturative process in southern Louisiana has been termed Cajunization (Waddel, 1979), because the singlemost important conditioning factor was the Acadian model. Simple geographic proximity and intermarriage resulted in the rapid enculturation (socialization) of Germans, Hispanics, Old World and Canadian French, Anglo-Americans, Indians, and doubtlessly people of other ancestral origins. Several authors have argued that geographical isolation was responsible for the distinctive Cajun lifestyle (Gilmore, 1933; Conrad, 1978a), but given the incredible absorptive quality of emergent Cajunism, isolation must be ruled out as an important factor. The continued admixture of peoples of various ancestral origins into the dominant Cajun group resulted in a cohesive, if somewhat hybridized, social phenomena that continues to exhibit dynamic and vibrant qualities that simply cannot be explained by geographic isolation.

E.6.21. Though the modern Cajun belongs to a distinctive group, whether viewed from within or without the social boundaries of ethnicity, ancestral origin often does not appear to play a major role in ethnic group definition.

E.6.22. Another social label that has been applied to French-speakers in the Atchafalaya vicinity is the term Creole. Like the term Cajun, Creole has confused and perplexed anthropologists and ethnic group members alike. Also similar to the term Cajun, the use of Creole as a noun in reference to a social category must be viewed in terms of diachronic and synchronic variations. These variations have in the past and continue in the present to accord varying degrees of emphasis on ancestral origin as a vital definitional criterion.

E.6.23. The present fieldwork in Atchafalaya communities confirmed the highly situational use of the term. An English-speaking Black man from Musson, who professed not to be a Creole, considered any French-speaking person a Creole. One French-speaking Cajun from Henderson considered Cajuns and Creoles as the same group. Another French-speaking Cajun from Henderson considered both Cajuns and Creoles to be of mixed ancestry but distinguished Creoles as having some black blood. A woman from Coteau Holmes, who had assimilated both Cajun culture and the Cajun language during her lifetime, considered Creole to be the same as mulatre (mulatto). If there are native black and white French-speakers who do consider ancestral origin as important in distinguishing identity, the present investigation failed to identify them.

E.6.24. Finally, there are French-speakers living in the Atchafalaya Basin area whose ancestors came directly from France to Louisiana at various times but who insist that they are neither Cajuns nor Creoles. The ancestors of some of these people, for example, were

French Royalists who fled to Louisiana during the French Revolution (Guitierrez, 1979). Thus, one might tentatively draw the conclusion that distinctive French ancestry might furnish the definition for a separate group of French-speakers apart from Cajuns or Creoles. However as the other dimensions of ethnicity are examined, it may be seen that "Frenchmen" neither constitute a clear grouping nor function collectively as a group separate from other French-speakers.

E.6.25. Italians are also prominant among the non-French speakers living in the Atchafalaya area. Between 1880 and 1910, more than 30,000 Italians immigrated to Louisiana, chiefly to work as laborers in the sugar industry (Rathburn, 1979). Italians are still numerous today in areas where sugarcane is grown or was once the major crop. Relatively large Italian enclaves were confirmed in Maringouin, Charenton, Morgan City, and St. Martinville. The Italians have not been as strongly affected by the Gallic acculturation process as the earlier immigrants to Louisiana. This is probably due to their relatively late arrival and exposure to the process of Cajunization, which itself was being influenced by a more generalized modern Americanization.

E.6.26. Unlike other groups, ancestral origin seems to play a prominant role in distinguishing Italians from other groups in the basin. As several informants have explained, the proof of Italian identity rests in surnames.

E.6.27. Perhaps the fastest growing group in the basin area today is an assortment of English-speaking Americans. The Anglo-Americans became the first nonaboriginal people to settle in and around the basin in the mid-eighteenth century, when Thomas Berwick set up farming operations around the current sites of Morgan City and Berwick (Grambling, 1978). The major period of Anglo-American migration to Louisiana began after 1803, and reached its peak between 1850-1860 (Treat, 1967). During this period, Anglo-American plantations sprang up both within and along the fringes of the basin. Plantations were located on bayous Maringouin, Grosse Tete, Sorrel, and Pigeon, and in the center of the basin along Bayou Chene (Comeaux, 1972), and in the southernmost reaches around present-day Morgan City (Grambling, 1978).

E.6.28. During the remainder of the nineteenth century, other Anglos from the North entered the area with the development fo the cypress lumber industry (Spitzer, 1979). Others took part in the fishing and trapping commerce that also was expanding. After the great 1927 flood, the population in the interior of the basin began to disperse. The Anglo-Americans generally resettled in the Morgan City and Lower Teche region or in the community of Bayou Sorrel on the eastern fringe of the basin. With the rising importance of Morgan City as a terminal for the oil industry, Anglo-American immigration to this area has drastically increased in recent years.

E.6.29. The Anglo-Americans are distinctively separate from other ethnic groups living in the basin area, but this distinctiveness seems to have little to do with ancestral origin. Throughout the nineteenth and twentieth centuries, acculturation across ethnic boundaries occurred. Individuals with English surnames, for example, are thoroughly integrated with and assimilated into Cajun communities along the western edge of the basin. On the other hand, a considerable number of individuals with French and Acadian surnames became ethnically Anglo. Case (1973) has pointed to a number of these individuals who lived at the Bayou Chene community before its dispersal, and Spitzer (1979b) has followed their resettlement to the Bayou Sorrel locality. Countless others can be found along the Lower Teche and in the Morgan City vicinity. Among the Anglos who became Cajun, as has been noted, ancestral origin has played no important role. Similarly, ancestral origin is a relatively insignificant factor to monolingual English-speaking individuals of Acadian or French descent who have intergrated into Anglo-American communities.

E.6.30. Yet another distinct group inhabiting the basin area includes English-speaking blacks, who are here referred to as Afro-Americans. Like the black Creoles, the Afro-Americans entered Louisiana as a result of the Atlantic slave trade. Originally at least, the distinctions between the black Creoles and the Afro-Americans were due to the ethnic affiliations of their owners. Slaves who were owned by Anglo-Americans generally arrived in Louisiana somewhat later than those belonging to French owners. Many were taken to Louisiana by planters from the Tidewater region after 1803 (Spitzer, 1979b). The settlement loci of these slaves corresponded to the location of Anglo-American plantations in the basin vicinity. After the Civil War, most Afro-Americans remained as share-croppers or tenant farmers on the same lands where their ancestors had settled. When the lumber industry expanded around the turn of the twentieth century, many blacks entered the Atchafalaya Basin on a seasonal basis as employees for large lumber operations (Marionneaux and Marionneaux, 1979). The Afro-Americans (as well as the black Creoles), however, were barred from entering the interior of the basin in pursuit of trapping or fishing careers by entrenched white groups who had already monopolized that economic niche.

E.6.31. Today, the majority of the Afro-Americans reside at or near their original locations. Sizable communities were noted in Amelia, along Bayou Maringouin, and in the Lower Teche region. Ancestral origin is no more important as a distinguishing feature of ethnicity among the Afro-Americans than it is among the black Creoles. Social and cultural factors, other than ancestry, separate this group from others of the area, factors which took effect after settlement in the New World.

E.6.32. Several other ethnic units, numerically less significant than those previously discussed, have settled in the basin vicinity. Of

these, the Jews are probably the most numerous. Jews have been in Louisiana since 1718 (Kaplan, 1957), but since they generally cluster around urban areas (Spitzer, 1979b), the basin itself has held little attraction. The most cohesive Jewish community in the vicinity is located in New Iberia and serves individuals from the Franklin and Jeanerette areas (Kaplan, 1957). A community leader and long-time resident of Amelia stated that a few Jews inhabit that community. If the Jews from elsewhere in the basin region are comparable to the community in New Iberia, it is safe to say that ancestral origin means little to the cohesion of their ethnic group. Kaplan (1957) reports that French, German, and Eastern European Jews comprise a single ethnic unit in the community at New Iberia.

E.6.33. The most recent ethnic group to enter the basin vicinity is comprised of Vietnamese refugees. Within the last 5 years, resettlement of these people by the Federal Government has brought them into the ethnic portrait of south central Louisiana. Large Vietnamese aggregates were observed in Henderson and Amelia. In the Henderson community, they work in the seafood industries; in Amelia, they are laborers in various oil field equipment fabrication plants. Though no Vietnamese were interviewed during this survey, other informants in the towns in which they live claim that the new arrivals form chohesive social units that remain largely apart from other parts of the communities. In this particular case, ancestral origin is a key factor in their distinctiveness.

E.6.34. The importance of ancestral origin as a factor of ethnic consolidation varies from group to group. Ethnic identity among the Chitimacha Indians, the Italians, and the Vietnamese does seem to depend, at least partially, on origin. Factors affecting the formation and continuity of other ethnic units in the basin vicinity, on the other hand, have considerably minimized the significance of ancestral origin.

LANGUAGE AND ETHNICITY

E.6.35. The following discussion does not constitute a substantial linguistic analysis of verbal behavior in the Atchafalaya area, or even of selected parts of the basin. Rather it is an inquiry into one small aspect of sociolinguistics; an inquiry centering on the question: "Is language a key factor to ethnic identity?"

E.6.36. It was stated previously that ancestral origin was pertinent to the makeup of a few ethnic groups; the Chitimacha Indians being and example. The social use of specific language competencies, on the other hand, does not seem to aid in defining Chitimacha ethnicity.

E.6.37. No language other than English was encountered during field work at the reservation. As a basically monolingual, English-speaking group, the Chitimacha are not distinguished by language from other English-speaking ethnic units in the basin area.

E.6.38. Another case in which language fails to circumscribe ethnicity may be found among the Islenos and other Hispanic peoples. Peoples of Hispanic ancestral origin around the basin have largely been assimilated into other ethnic groups. Over the years, assimilation has included the Spanish language.

E.6.39. French language use in the basin, has, however, remained an integral means of communication. In South Louisiana in general, there are, in the estimation of some linguists, four variant forms of French in use: Standard, Cajun, Creole, and the Acadian variant heard in the Breaux Bridge area (Waddel, 1979). Along the fringes of the Atchafalaya Basin, two of the forms dominate, Cajun and Creole.

E.6.40. The following discussion centers on the relevance of the two spoken French forms, Cajun and Creole, to the matter of ethnic identity. The Cajun language, whether dialect, patois, or whatever, is widely spoken in villages along the western fringe of the basin as well as in the areas of Pierre Part, Belle River, and Bayou Pigeon, located on the east side of the basin. Creole, on the other hand, is distributionally limited to the western edge of the basin. The two variants are distinctive. In extremely simplified terms, Cajun is a seventeenth century version of rural French containing certain French archaisms, a number of loan words from Spanish, English, and various Indian languages (Read, 1931), and a simplified grammar (Phillips, 1978). Creole is perhaps best understood as a French lexicon within an Africanized phonology and unique syntax (Spitzer, 1979a). Spitzer (1977) notes that in its "deepest form," Creole is unintelligible to speakers of Cajun French.

E.6.41. Waddel (1979) suggests that there is some coincidence between distinctive racial groups and the variants of French spoken; Creole is often associated with the black Creole group, while Cajun is associated with the white population identified externally and internally as Cajun. He further notes, however, that many whites and blacks are bilingual in Creole and Cajun and that Creole appears to be the dominant form among both blacks and whites in the Atchafalaya area. Survey encounters with several white Creole-speakers confirm that these forms of French should not be strictly linked with race.

E.6.42. In one sense, survey information overwhelmingly indicates that personal and group identity is defined by French verbal behavior. Most French-speakers in the basin area have some competence in the English language. The identity of bilingual speakers is often defined within the complex rules governing code switching (Eidheim, 1969), and switching between English and French does have identity

connotations. In public situations, French is used among relatives, members of the same occupational groups, friends, and other "in-group" acquaintances, while English is used with preceived "outsiders." Quite often, French is used as a "secret code" to allow insiders to communicate messages not intended for the ears of outsiders.

E.6.43. In another regard, in every French-speaking community visited during the survey, the failure of French usage to cross generational boundaries was noticed. In Catahoula, one of the most characteristically French communities in the Atchafalaya region, a knowledgeable community leader stated that individuals under 35 years of age often do not speak French. The implications of this finding for ethnicity are clear. The French language is an important identity marker among French-speakers, but it is not essential to defining ethnicity of their children who, by dint of consanguineous ties, are also numbered among ethnic group members.

E.6.44. To a more particular issue, it may be asked if the Creole-Cajun language dichotomy provides a key boundary marker for separate identity groups among French-speakers? The answer seems to be no, or at least it provides an unreliable indicator. In addition to the factor of inter-generational discontinuity previously discussed, there is a widespread bilingual competence in both language forms. Since black and white French-speakers alike use both Creole and Cajun forms, there is no clear ethnic dichotomy predicated on them alone.

E.6.45. Another case in which language seems to be a paramount link to ethnic definition involves the Vietnamese. Informants in Henderson and Amelia testify that most of the adult Vietnamese speak little or no English. There are presently adult classes being held in Amelia to teach basic conversational English, but only a very small percentage of adult Vietnamese attend these classes. Vietnamese children, on the other hand, attend public schools and are learning English at a much rapid pace. Often, the children act as tutors and translators for the adults. In Henderson, one informant noted that some Vietnamese show a remarkable propensity for the English language but, in general, a communication gap exists between locals and that oriental group.

E.6.46. Excluding French and Vietnamese, English is the only other language of widespread social importance in the basin. There may be Italians who have retained some competence in that language but, if so, their numbers must be relatively small and, more importantly, no evidence of the social relevance of Italian has been discovered. Some Italians may speak French as a second language, but the majority are monolingual English speakers.

E.6.47. The Anglo-Americans, Afro-Americans, Italians, Chitimacha Indians, and Jews (as far as can be ascertained) are predominantly English-speakers. Their common use of English does distinguish them from French-speaking individuals inhabiting the basin area.

RACE AND ETHNICITY

E.6.48. The concept of race as used here does not pertain to physical genotypical characteristics. The concept of a "pure" race, in the empirical sense, has long been abandoned by anthropologists. If the concept itself ever had usefulness, its applicability to south Louisiana would be especially hard to justify. The fact, however, that perceived racial differences are important has nothing to do with the empirical validity of any biological category. Race is definitely a cultural category. Isajiw (1974), invoking Barthian subjectivism, pointed out that when the subjective self-definitions "of people remain the same over a period of time, they become part and parcel of the people's culture." Race, as a category of ascription and self-ascription is a factor in ethnicity.

E.6.49. Perceived racial affiliations do structure intergroup relationships in the Atchafalaya region. Chitimacha Indian ethnicity, for instance, is officially defined in racial terms. To be a Chitimacha, one must be prepared to prove at least one thirty-second Chitimachan "blood." This racial expression forms the border between their group and others who do not possess Chitimacha racial features. While this view may not coincide with various definitions of Indian identity maintained by the Federal Health Education and Welfare Department (Daily Advertiser 1979), it is of considerable importance on the Charenton reservation.

E.6.50. Racial categorization also contributes to ethnic distinctions between French-speaking groups in the Atchafalaya Basin vicinity. It involves the black-white dichotomy. This fact is not particularly evident from the literature of Acadians, no doubt because racial categorization frequently is not pertinent to social identity in many areas. Blacks are often considered legitimate members of the Cajun group, and either black or white may be Creole. Nevertheless, evidence gathered during the survey unequivocally indicated that racial categorization as perceived by white French-speakers is essentially important to ethnic distinctiveness. It was discovered that both black and white French-speakers of the Henderson area are Catholic, speak the same languages, and have similar cultural traits. The black French-speakers, however, do not attend Our Lady of Mercy Catholic Church in Henderson because, as informants indicated, they are not welcome there.

E.6.51. White French-speakers living around the fringe of the basin, referred to here as Cajuns, do not consider that blacks, no matter which language, religion, or culture they practice, belong to the same ethnic group as they themselves do.

E.6.52. There are other evidences of ethnic dichotomization based on race. This dichotomization is apparent in the physical spatial segregation and/or complete absence of black settlement in many

Basinal communities. Krotz Springs, a community inhabited by both Cajuns and Anglo-Americans, has no black residents. There are no blacks in the Anglo community of Bayou Sorrel. In Amelia, which is predominantly Anglo-American but with a strong Cajun contingency, Afro-Americans live within a small geographically distinctive precinct. Settlement outside the boundaries of the Chitimacha reservation.

E.6.53. The Hispanic race, or the broader Latin category, seems to be of less importance in defining ethnicity than either "black" or "red" categories. This survey found no evidence of an ethnic group comprised entirely of Hispanics.

E.6.54. Members of two other basin groups may consider racial categories as important to ethnic definition. The Jews, though none were interviewed by the survey team, generally seem to espouse the belief of Jewish racial separation. This attitude of racial distinctiveness could be based upon an extremely high rate of endogomy among the Jews (Kaplan, 1957). The Asian race also, for the time being at least, significantly sets the Vietnamese apart from other ethnic groups. Race seems to be one of many characteristics that results in their distinctiveness.

E.6.55. In conclusion, while there are no empirically valid, biologically distinct "black" or "white" races in the basin area, these culturally perceived racial categories are pertinent to ethnic boundaries. Black-white dichotomization is essential in distinguishing Cajuns from black Creoles, and Afro-Americans from Anglo-Americans. This dichotomy probably affects the self-definition of Italians and individuals of Hispanic stock as well. In the case of the Chitimacha, this white-black dichotomy "colors" the blood rules of ethnic identity to which they ascribe. The Vietnamese, and possibly the Jews, are distinguished by racial characterizations that exceed this simple white-black duality.

RELIGION AND ETHNICITY

E.6.56. Apart from the peculiarities that mark French Catholicism, the Catholic religion delineates ethnic boundaries in a more general way. The Catholic religion, in general, does not act as a boundary mechanism among the Cajuns, black Creoles, Chitimacha, Italians, or Vietnamese. They are predominantly Catholic. If anything, the Catholic religion serves as a bond among these peoples. Granted that the bond is often tenuous, certainly not strong enough to dissolve ethnic distinctions, it nevertheless sets these groups apart from the Anglo- and Afro-Americans who generally adhere to various protestant denominations.

E.6.57. The boundary between Catholicism and Evangelical Protestantism cannot be easily mapped. It seems logical to view the entire Atchafalaya region, both eastern and western fringes, as a zone of blurred boundary distinctions between Catholicism and Protestantism, at least in the gross geographical sense.

ETHNICITY AND CULTURE

E.6.58. As previously mentioned, Isajiw (1974) determined that "same culture" or "cultural traits" was a category of attributes chosen frequently by social scientists to define ethnic groups. It is clear that some if not all of the categories previously discussed could easily have been subsumed by this heading. Language, religion, and cultural perceptions of race are all cultural categories. It could likewise be argued that ancestral origins, and myths surrounding them, should also be included under a category of cultural attributes. The fact is, the concept of culture is so inclusive that compartmentalization is necessary to facilitate analysis. Since the relationships between ethnicity and ancestral origin, language, race, and religion have already been discussed, this residual category deals with everything cultural that has not been covered.

E.6.59. Symbols of ethnicity are occasionally corporal entities wrought by human hands. Examples of these objects can be seen at the Chitimacha tribal museum. As a class of objects that represent continuity in uniquely Chitimacha custom, they are a symbol of Chitimacha identity.

E.6.60. But symbols of ethnicity need not be works of art or even be skillfully executed. Wherever Cajuns live around the fringes of the basin, statues of the Virgin Mary can be seen enshrined in front yards. The placement of many of these shrines atop liquid gas tanks in rural areas has inspired Rushton's appellation, "Our Lady of the Butane Tank" (1971).

E.6.61. Another symbol of Cajun ethnicity is the crawfish. As a symbol of dauntless tenacity and stubborness, the Cajun sees the crawfish as an embodiment of his own personality. The crawfish symbolizes unwillingness to change. The Atchafalaya Basin is the home of the crawfish and is a symbol of Cajun ethnicity.

E.6.62. Anglo-Americans do have institutions that contribute to their ethnic solidarity. One of these, the Accelerated Christian Education (A.C.E.) schools, can be found in Bayou Sorrel and, suprisingly enough, in Pierre Part. These schools resulted from fundamental Baptist reactions against the public school system, particularly the teaching of evolution. Bible passages are the "textbooks" for grades kindergarten through twelfth. This school system personifies the

characteristics of independence held by many of the Anglo-American residents of the basin area.

E.6.63. The Vietnamese, Italians, and Jews also have peculiar cultural traits that figure in the maintenance of their ethnic identity. Unfortunately, the limited field work did not produce any new data relevant to these groups.

ETHNIC GROUPS IDENTIFIED

E.6.64. The present research in the Atchafalaya Basin has resulted in the identification of eight separate ethnic units: the Chitimacha, Cajuns, black Creoles, Anglo-Americans, Afro-Americans, Italians, Vietnamese, and Jews. Various combinations of ethnically pertinent attributes distinguish these groups from one another. Considerable difficulty plagued attempts to divide the French-speakers of the Atchafalaya region into ethnic constituents. These populations have been classified into two ethnic units, the Cajuns and the black Creoles.

FOLK CULTURE IN A FOLK SOCIETY

E.6.65. Several important sociocultural and technoeconomic realities of the Atchafalaya area do not conform to the ideal folk society. While some individuals choose to live in remote settings, for instance, no social unit can truly be described as isolated. Illiteracy is common among individuals, but the term cannot be applied to any social group. Nineteenth and twentieth century contact with industrial America has insured a level of technological complexity, which presumably neither Redfield (1947) nor Foster (1953) would accept as characteristic of a folk society. And, while swamp exploitation is intergrated into the independent lifestyle of many locals, profit cannot be underestimated as a prime motivator. In short, the folk industries described by Comeaux (1972) do not generally fit traditional conceptions of the folk society.

E.6.66. Other characteristics of social groups in the swamp area, however, suggest that folk societies do exist. Relatively small communities of individuals who share intimate communications through daily face-to-face relationships are found along the fringes of the basin. In many cases, these communities are populated by individuals who share a set of generally homogenous customs. Some of the societies, particularly those composed of Cajuns, black Creoles, and Chitimacha Indians, do have powerful, sacred components that seem to touch nearly every aspect of social life.

E.6.67. Inasmuch as some communities are linked to, or separated from, others on ethnic grounds, there appears to be more than one folk society. In fact, the concept of the folk society corresponds quite well with that of the ethnic group. Both are biologically self-sustaining groups whose members fill all of the necessary social roles. Members of both groups generally speak the same language and share a homogenous set of customs and values. No segregation occurs among members of the same ethnic group or folk society based upon racial perceptions.

E.6.68. On a conceptual basis, however, there seems to be one important factor that separates the folk society from the ethnic group--the manner in which group cohesion is maintained. If ethnic group cohesion can be fostered and maintained by formal educations, the cohesion of folk societies can not. The traditions and customs that bind the folk society are transmitted by way of folklore. Folklore may occur in a variety of forms, including verbal and nonverbal behavior, as well as material objects that embody important stylistic conventions, but there is no room in the folk society for formal socialization.

E.6.69. In the Atchafalaya Basin region, ethnic groups and folk societies cannot be distinguished from one another in terms of socialization. Though public education is offered in the area, the body of conventional understandings that contribute to group cohesion is not taught in the classroom. To the contrary, formal education tends to socialize the student to standard American norms which threaten to replace the distinctiveness of both ethnicity and folk culture. But for the present, despite the onslaught of modernization, it is still possible to identify folk societies. These groups do not perfectly correspond to Redfield's ideal construction of the folk society, but neither do they approach the ideal type that occupies the opposite end of the rural-urban continuum.

FOLK CULTURE OUTSIDE THE FOLK SOCIETY

E.6.70. As previously mentioned, folk culture articulated upon exploitation of swamp resources cannot be ascribed to any particular social group. Anglo-Americans, Cajuns, Indians, and members of other social units share a more or less homogenous set of adaptive strategies pertaining to swamp exploitation. These folk activities include wetland lumbering, fishing, crawfishing, crabbing, frogging, trapping, turtle industry, alligator hunting, game hunting, bee industry, and the moss industry. Brassieur (Gibson et al., 1980) and Comeaux (1972) describe these folk industries in detail.

CONCLUSIONS

E.6.71. The term "folk culture" has been defined as shared conventional folk understandings. In reviewing traditional concepts of the folk society, it has been seen that folk culture exists both within particular folk societies and outside their boundaries as well. But whether folk culture occurs within a societal whole or within a specific societal segment, such as an occupational group, it is maintained and transmitted by folklore. Folklore, which embodies verbal or nonverbal behavioral or material forms, is the analytical unit that puts the researcher in touch with folk culture. The study of folk culture is necessarily a study of folklore.

E.6.72. Within this century, the Atchafalaya Basin has changed from a watery cypress wilderness to a semi-wild spillway that is rapidly on course to total mastery by a dominant industrial civilization. In 1980, there are still living culture bearers of a way of life that adapted to the great swamp in its pristine conditions. One can still hear stories of cypress stands that defy comparison to anything presently growing in the basin; of catfish longer and heavier than the fisherman who dragged them out of the swamp; of panthers that could swim faster than a pirogue; of entire fishing communities built on piers in the middle of the swamp; of great floods of 1882, 1912, and 1927; and of steamboats that plied Atchafalaya and Bayou Teche waters. In the all-too-near future, the bearers of these folk memories will no longer be around to share the understandings of a landscape and cultural adaptation that is doomed to extinction. As significant cultural resources, folklore and the bearers of Atchafalaya Basin folk culture deserve considered attention.

Section 7 - NATIONAL REGISTER PROPERTIES

E.7.1. The National Register of Historic Places, published in the "Federal Register" dated 6 February 1979 and the monthly and annual supplements through 27 October 1981 has been consulted and only two cultural resources 16SM45 and 16SMY52, within the Atchafalaya Basin Floodway have been determined eligible for inclusion in the National Register (US Department of Interior, 1979). The Nutgrass archeological site, 16SM45, is a significant shell midden located on the west bank of the Port Allen-Morgan City Intracoastal Canal south of Belle River Landing, Louisiana. The site was discovered and investigated by Louisiana State University during their extensive preliminary survey of the Atchafalaya Basin in 1974 and 1975 (Neuman and Servello, 1976). Subsequent to its determination of eligibility to the National Register, the Nutgrass site was protected from erosion by placement of stone on the bank and adjacent underwater slope by the US Army Corps of Engineers in 1975. The Avoca Island Pumping Plant Number 1, 16SMY52, is located on the east bank of Bayou Shaffer south of Morgan City, Louisiana. The structure was a key element in a pioneering land reclamation project in the Louisiana marsh. Built between 1910 and 1914, the plant was one in a system of three pumping stations which drained the 16,000 acres of Avoca Island. The property was investigated during the intensive cultural resources survey of the East and West Atchafalaya Protection Levees conducted by the University of Southwestern Louisiana in 1979-80 under contract to the US Army Corps of Engineers, New Orleans District (Gibson et al., 1980). No other cultural resources in the project-affected area are presently listed in or have been determined eligible for inclusion in the National Register.

E.7.2. The draft report on the findings of the cultural resources survey of the East and West Atchafalaya Protection Levees identified 12 cultural resources in the survey corridor as significant and eligible for inclusion in the National Register. These 12 resources include the Nutgrass archeological site, 16SM45, which had previously been determined eligible for the National Register, and the Avoca Island Pumping Plant Number 1, 16SMY52, which has subsequently been determined eligible to the National Register.

E.7.3. Because the Avoca Island Pumping Plant Number 1, 16SMY52, is located in the potential environmental impact area of the project, a determination of eligibility was requested from the Keeper of the National Register pursuant to Title 36 CFR, Part 800. The resource was determined eligible on 14 September 1981, and a determination of no effect was executed on 14 September 1981 after minor alteration of the project design to avoid any impacts on the property.

E.7.4. Four of the 12 significant resources (16SYM104, 16SMY107, 16AV33, 16AV35), although located in the survey corridor, are not located in the potential impact area of the project; and therefore, no further action is planned. For the remaining 7 significant resources (16IV4, 16SM75, 16SMY130, 16SMY66, 16SMY2, 16SM50, Register-eligible 16SM45), precise construction limits have not yet been determined. As project design continues, a determination of eligibility will be requested and the compliance procedures outlined in Title 36 CFR, Part 800 will be initiated for each of these resources located in the potential impact area of the project.

E.7.5. In addition, the intensive cultural resources surveys of the other project features of the selected plan, which will be conducted during the next stage of planning, may locate additional cultural resources eligible for inclusion in the National Register.

E.7.6. Numerous historic resouces located on the Bayous Grosse Tete, Lafourche, and Teche natural levee ridges bordering the Atchafalaya Basin have been included in the National Register of Historic Places. These, however, are located outside of the project-affected area.

Section 8 - NATIONAL TRUST PROPERTIES

E.8.1. The only National Trust property in Louisiana is Shadows-on-the-Teche, located on the west bank of Bayou Teche in Iberia Parish. Built during 1831-1834, this was the home of David Weeks, a wealthy planter and landowner. It is a two-story porticoed mansion with eight giant Tuscan columns and a second floor veranda. No major changes have been made in the house since the Civil War. Shadows-on-the-Teche is located outside and west of the project-affected area.

Section 9 - SIGNIFICANT RESOURCE CATEGORIES

E.9.1. Based upon information provided in the previous sections of this report and the guidelines provided in US Army Corps of Engineers regulation entitled, "Environmental Quality: Policy and Procedures for Implementing NEPA," four significant cultural resources categories were identified in the study area. These four categories include National Register Properties, National Trust Properties, Archeological Resources, and Culture of the Basin. The rationale for selection of each of these categories is provided below.

E.9.2. National Register Properties. Historic properties listed or determined eligible for inclusion in the National Register of Historic Places are significant resources by virtue of their National Register status. The National Register of Historic places was established as the key management tool for cultural resource management in 1966 by enactment of the National Historic Preservation Act. This law and the various other Federal mandates that created the cultural resource management field require that all Federal agencies having direct or indirect jurisdiction over Federal or Federally-assisted and licensed activities "take into account" the effects of the proposed undertaking on significant cultural resources. A significant cultural resource is defined by these Federal mandates and the resulting Federal regulations as one that meets the criteria for inclusion in the National Register of Historic Places contained in Title 36 Code of Federal Regulations, Part 60.6.

E.9.3. National Trust Properties. Historic properties of the National Trust for Historic Preservation are considered significant resources, having been identified by this private organization as important resources worthy of preservation.

E.9.4. Archeological Resources. The National Register of Historic Places is the key management tool for identifying significant cultural resources. However, the archeological resources category was included as a significant resource to take into account the archeological resource base in the study area. This was necessary because of the site specific nature of the National Register category and the limited cultural resource survey coverage in the basin.

E.9.5. The destruction and loss of the archeological resource base in this nation has long been a concern of the public and the archeological profession. This fact is evidenced by the Federal mandates of past decades that have established a national policy of

enhancement and preservation of cultural resources. It is, therefore, appropriate to consider as a significant resource the known and suspected cultural resource base of the Atchafalaya Basin.

E.9.6. A further reason for inclusion of this category is the incomplete cultural resource survey coverage of the project-affected area. Only the levee raising feature of the alternatives has been subject to intensive survey. Future intensive cultural resources surveys of other features of the selected plan will undoubtedly locate additional cultural resources eligible for inclusion in the National Register. Therefore, to restrict consideration of archeological resources to those presently included in the National Register would not adequately address the impacts of each plan upon cultural resources. This category allows assessment of alternative impacts relative to the resource base in general rather than assessing impacts only upon the few presently identified National Register and Register-eligible properties.

E.9.7. Culture of the Basin. The rationale for selection of this significant resource category includes the expressed public concern over the potential effects of the selected plan upon the traditional culture of the basin. Additional considerations for significant resource designation are the unique nature of the basin's culture, the fragility of this resource, and the great impact upon this resource that could result from implementation of the selected plan. This significant resource category allowed consideration of the culture of the basin during alternative formulation and assessment of alternative impacts.

Section 10 - ALTERNATIVE IMPACT ASSESSMENT

NATIONAL REGISTER PROPERTIES

E.10.1 Plan 4 (EQ)--1980 to 2030. With this plan, the ongoing levee enlargements would possibly affect one National Register property in the basin, 16SM45, and 6 of the sites identified by the cultural resources survey as potentially eligible for inclusion in the National Register. The effects of the levee enlargement feature of this plan upon each of these significant cultural resources is being determined as project design continues. The full impact of this plan upon National Register properties cannot be addressed without the benefit of an intensive cultural resources survey of all the project features. Such a survey will be conducted for all features of the selected plan during the next stage of planning.

E.10.2. Compared to the without-project conditions, this plan would not impact any additional cultural resources presently listed or determined eligible for inclusion in the National Register of Historic Places, since levee enlargement is a feature of the without-project conditions. However, the other project features under this plan would possibly impact additional cultural resources identified by future investigations as eligible for inclusion in the National Register.

E.10.3. Plan 4 (EQ) - 2030 to 2080. Since maintenance of an adequate flowline could necessitate continued levee enlargements during the second half of project life, this plan would possibly impact additional cultural resources eligible for inclusion in the National Register.

E.10.4. Plans 7 (NED) and 9 (Recommended Plan). Same as Plan 4.

NATIONAL TRUST PROPERTIES

E.10.5. Plan 4 (EQ). With this plan there would be no effects upon Shadows-on-the-Teche, the only National Trust property in the study area.

E.10.6. Plan 7 (NED). Same as Plan 4.

E.10.7. Plan 9 (Recommended Plan). Same as Plan 4.

ARCHEOLOGICAL RESOURCES

E.10.8. Plan 4 (EQ)--1980 to 2030. Although the full impact of this plan cannot be determined due to an incomplete data base and the preliminary level of design, the effects can be estimated based upon known site locations and prehistoric and historic settlement information. The ongoing levee enlargement would adversely affect numerous recorded archeological sites, some of which are possibly eligible for inclusion in the National Register.

E.10.9. The environmental easements of this plan would be beneficial to the conservation of archeological resources by placing an easement regulating land clearing and excavation over all property in the basin except developed ridges and state-owned land. Although such an easement would protect cultural resources from unregulated land development, oil and gas exploration would not be restricted and these activities will continue to damage archeological resources. Additionally, the 105,000 acres of public access lands as well as the 1,500 acres of recreational development under the real estate feature would subject archeological resources in these areas to vandalism and pothunting due to increased public access. The creation of management units for enhancement of natural resources would, to some degree, protect archeological resources located within the units by preventing most land alteration. But as with the environmental easements, the continuing oil and gas exploration and increased public access would adversely affect archeological resources in these units. The land alteration related to construction of the management units, recreation development, and other major project features would impact many recorded sites and undoubtedly more presently unrecorded sites.

E.10.10. Compared to the future-without conditions, this plan would prevent the conversion to agriculture of 183,500 acres of forested land in the basin. Thus, this plan would lessen the destruction of archeological sites due to land-use changes. This would be accomplished by restricting development, through environmental easements and mangement units, in undeveloped areas of the basin which, under the future-without conditions, would be subject to unregulated land development as the basin silted in. However, this plan would involve construction impacts related to major project features that are not included in the without-project future. Also, the expanded public access to the basin would increase the incidence of pothunting and vandalism of archeological sites.

E.10.11. Plan 4 (EQ) - 2030 to 2080. During the second half of project life, additional levee enlargement would continue to impact archeological resources located on the edges of the floodway.

E.10.12. Plan 7 (NED) - 1980 to 2030. With this plan, 204,000 acres of presently forested land in the basin would be subject to clearing and conversion to agriculture by the year 2030. Approximately 27,500

acres of this clearing would occur along the natural levees in the backwater area because of the stabilized water levels resulting from the extension of the Avoca Island levee. The unregulated land development that would occur in the basin would result in adverse impacts to scores of archeological resources. Sites presently protected by their location in seasonally flooded areas would be impacted as agricultural and urban expansion followed sedimentation and draining of the swamps. The increased recreational use of the basin due to the acquisition and development of 1,500 acres of recreation lands would subject archeological sites in the basin to vandalism and pothunting. Additionally, construction related to major project features would impact numerous recorded sites.

E.10.13. Compared to the future-without conditions, this plan would be detrimental to archeological resources because it would accelerate the processes of siltation, clearing, and conversion to agriculture. This plan would involve an additional 18,900 acres of clearing over the without-project conditions by the year 2030. This plan would also involve construction impacts related to major project features that are not included in the without-project future. Also, the expanded public access to the basin would increase the incidence of pothunting and vandalism of archeological sites.

E.10.14. Plan 4 (EQ) - 2030 to 2080. During the second half of project life, additional levee enlargement would continue to impact archeological resources located on the edges of the floodway.

E.10.15. Plan 9 (Recommended Plan). Similar to Plan 4.

CULTURE OF THE BASIN

E.10.16. Plan 4 (EQ)--1980 to 2030. With this plan, no extension of the Avoca Island levee is included. Thus, flooding caused by backwater influences on the east of the floodway will become more frequent and to greater depths in relation to the rate of delta development. This could lead to displacement of commercial fishermen and other swamp exploiters currently residing on these natural levees. However, the increasing frequency and depth of backwater flooding could beneficially affect the marine biological productivity of the backwater area and thus, the traditional utilization of the area. The environmental easement and the management units under this plan would serve to enhance the natural resources upon which the economy of the basin's folk culture is based. However, the greatly increased recreational use of the basin above the base condition due to expanded public access and recreational development would bring recreationists into conflict with the existing commercial exploitation of the basin. The disruption of existing access routes and the limited access that would be provided by the management units would

affect the traditional exploitation of the basin and cause competition over limited access facilities. The ongoing levee enlargement would continue to displace people in the Henderson Lake and Catahoula areas.

E.10.17. Compared to the future-without conditions, the implementation of this plan would lessen the sedimentation rate and restrict land clearing in the lower basin. The environmental easements would restrict excavation and land clearing over all property in the basin except developed ridges and state-owned property. The five management units would serve to enhance natural resources through control of water regimes. In addition, the sediment control features of this plan would further enhance natural resources. Thus, this plan would slow the deterioration of the natural conditions, which are the bases of the traditional economy of the basin's inhabitants. This would be accomplished by preventing the conversion to agriculture of 183,500 acres of forested land in the basin by the year 2030.

E.10.18. However, the acquisition of 105,000 acres for public access under the Real Estate feature would greatly increase recreational use of the basin's resources beyond the projected future-without conditions. Increased recreational use of the basin would necessarily conflict with established commercial patterns of use. The construction related to the establishment of the five management units would affect the traditional access routes into the basin's interior and cause competition over limited access facilities.

E.10.19. Plan 4 (EQ)--2030 to 2080. During the second half of project life the same processes decribed previously would be expected to continue.

E.10.20. Plan 7 (NED)--1980 to 2030. The siltation, clearing, and conversion to agriculture of 204,000 acres of presently forested land in the floodway and backwater area by 2030 under this plan would have detrimental and far-reaching effects upon the folk culture of the basin. The loss of this natural habitat would result in a concurrent decline in the quantity and quality of the resources available for utilization by the basin's inhabitants. Traditional occupations would necessarily be abandoned in favor of employment in the petroleum and other industries. Folk traditions, adaptive skills, and crafts would be lost in a relatively short time period. The increased recreational use of the basin due to the acquisition and development of 1,500 acres of recreation lands would lead to conflicts between the recreationists and the traditional commercial fishermen over the dwindling resource base. Therefore, deterioration of the resource base and the increased competition from recreational users would adversely and irrevocably impact the folk culture existing in the basin.

E.10.21. Compared to the future-without conditions in the year 2030, this plan would essentially accelerate the processes of siltation and draining of the swamps and would involve the clearing of an additional

18,900 acres of forested land. The increased recreational access to the basin over the future-without conditions would cause conflicts between the recreationists and commercial fishermen over the dwindling resource base.

E.10.22. Plan 7 (NED)--2030 to 2080. During the second half of project life, an additional 25,000 acres of forested land would be subject to land clearing and conversion to agricultural use. This would continue the deterioration of swamp productivity and further disrupt the traditional folk culture.

E.10.23. Plan 9 (Recommended Plan). Similar to Plan 4.

Section 11 - FUTURE CULTURAL RESOURCE REQUIREMENTS

E.11.1. The US Army Corps of Engineers' responsibilities and procedures for identification and administration of historic and cultural properties are outlined by the Advisory Council on Historic Preservation regulations, "Protection of Historic and Cultural Properties," (Final Amendments 36 C.F.R. 800) and US Army Corps of Engineer regulation, "Identification and Administration of Historic Properties." The reader is referred to these regulations for details of the compliance process.

E.11.2. Briefly stated, during the next stage of project planning an intensive cultural resources survey of the entire project impact area will be conducted to determine the number and extent of the resources present. The survey will result in data that is adequate to determine resource eligibility for inclusion in the National Register of Historic Places. Any cultural resource determined eligible for inclusion in the Register and which would be adversely affected by the project would be avoided, protected or, in the absence of a feasible alternative, mitigated by data recovery.

Section 12 - INTERPRETIVE POTENTIAL

E.12.1. The numerous archeological sites and the rich cultural heritage of the Atchafalaya Basin offer great scientific, educational, and interpretive potential. The proposed recreational development plan recognizes this potential by recommending that the project visitor center be located at Bayou Sorrel Mounds (16IV4). The reader is referred to Appendix F, Recreation Resources, of this report for further information.

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APPENDIX F

RECREATION RESOURCES

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Appendix F

RECREATION RESOURCES

F.0.1. This appendix presents basic data, calculations, and detailed considerations employed in analyzing and assessing the existing and potential recreation resources and needs of the project area. It also describes the rationale for proposing a recreational plan of development consistent with planning goals and objectives which are also compatible with other plan features.

Section 1 - INTRODUCTION

F.1.1. The Atchafalaya Basin offers an extensive array of recreational use potentials because of its natural, semi-wilderness setting (see Appendix A). These potentials have been recognized for years.

F.1.2. A preliminary master plan, DM No. 33A, dated April 1967, presenting a plan for construction of 31 access areas in the Atchafalaya Basin Floodway was prepared for the project. The Chief of Engineers by second indorsement, dated 15 September 1967, approved 26 of these areas for detailed planning and deferred the other five pending further consideration. The parish police juries refused the required local cooperation on two sites. Local interests have developed three sites. The Bayou Courtableau control structure was deferred pending decision on location and design of the structure.

F.1.3. A public use plan, DM No. 34, dated August 1972, was subsequently prepared, proposing Federal construction of the remaining 20 access sites that would be locally operated and maintained.

F.1.4. This public use plan was reviewed as part of the overall Atchafalaya Basin study effort contained in this report. In addition, a comprehensive analysis was made of all the basin's recreational resources, with a view toward maximizing public accessibility and use while minimizing adverse impacts on the existing biological and physical environment.

F.1.5. Much of the recreation planning effort was coordinated with representatives of the Agency Management Group to include the many diverse and sometimes conflicting interests in the floodway on a local, state, and national scale, and because of the difficulty in developing a multipurpose program for managing the various features of the project (i.e., flood control, environmental, recreational, cultural, etc.).

F.1.6. Major developmental constraints included the flood-prone nature of the floodway, the extensiveness of privately-owned land, and limited public access. All of these factors influence recreation and natural resource planning and development considerations.

Section 2 - RECREATIONAL DEMAND AND NEED ANALYSIS

OVERVIEW OF METHODS AND OBJECTIVES

F.2.1. A regional analysis approach was used to determine priorities with respect to recreational needs. The approach is a generalized way of presenting recreational supply/demand relationships for land and water use within the project market area and is similar to that used by many states in preparing their Statewide Comprehensive Outdoor Recreation Plan (SCORP).

F.2.2. The analysis had three objectives: first, to determine the demand for 10 water-based and 14 land-based recreational activities within the project market area; second, to translate demands for 17 of these activities into facility needs (demands for the remaining seven activities were not converted into needs because meaningful supply figures for those activities could not be ascertained); and third, to use this information in identifying potentials for recreational and fish and wildlife development in or along the project areas.

F.2.3. The scope of the analysis included 20 south-central Louisiana parishes that encompass the project and form the project market area (Figure F-2-1). Demand and need are projected for target years 1980 and 2030, which span that portion of the project life for which such projections could realistically be made.

F.2.4. Because of the complexity of this analysis and the nonavailability of current, extensive base data, usable information necessary to complete the analysis had to be extrapolated from several sources. Sources and methods of extrapolation will be discussed as the analytical demand equation is detailed.

F.2.5. The complete demand-need determination equation is complex; but viewed in its most simplistic form, it is composed of three elements: demand, supply, and need. Need is defined as that amount remaining when all demand is compared with the existing supply: (demand - supply = need). These three components, in turn, require numerous interim calculations in their respective determinations. They are discussed in the following paragraphs.

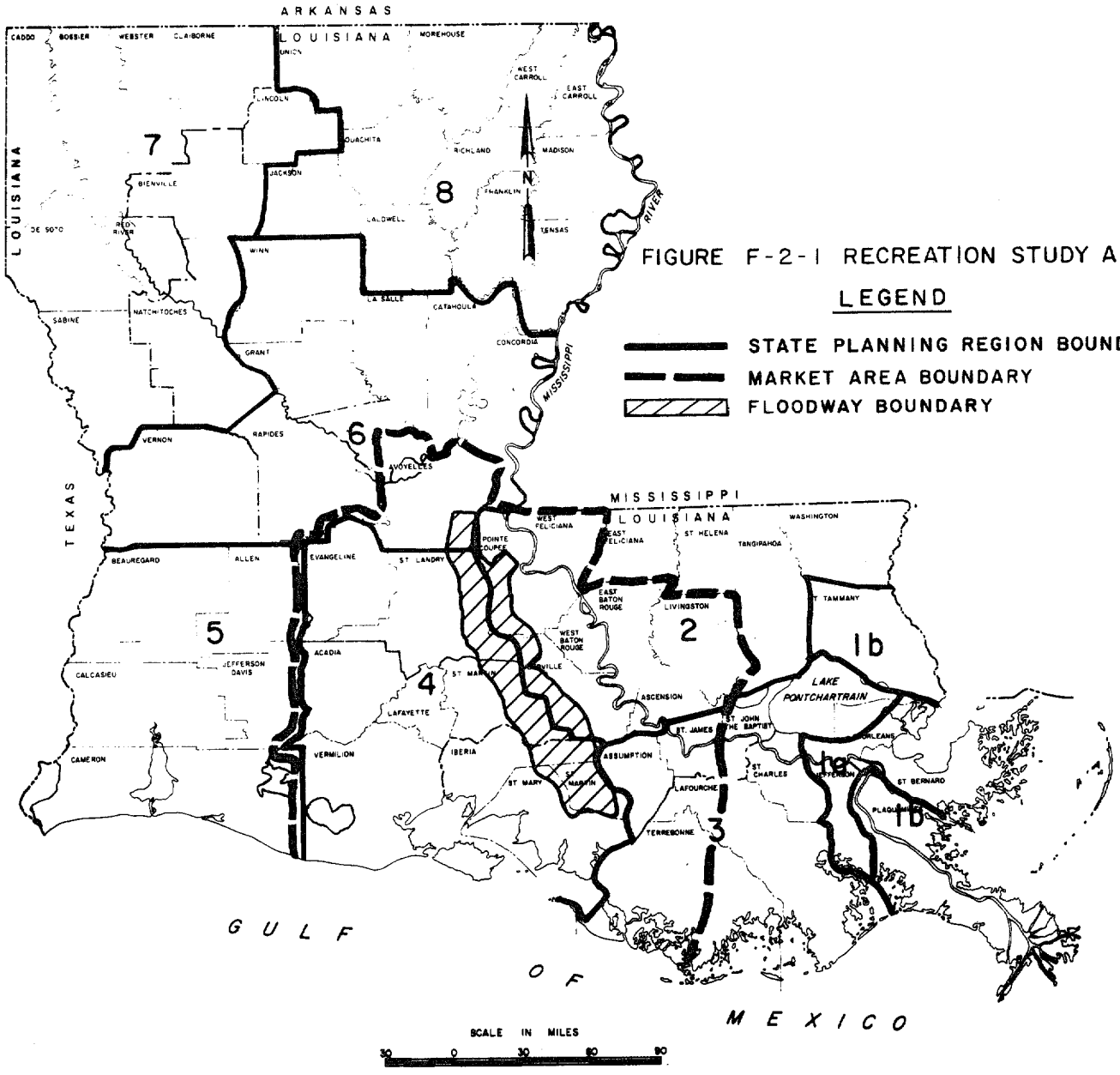

FIGURE F-2-1 RECREATION STUDY AREA

LEGEND

- STATE PLANNING REGION BOUNDARY
- MARKET AREA BOUNDARY
- FLOODWAY BOUNDARY

DEMAND

F.2.6. Demand is commonly viewed as an expression of desire to engage in an activity by an individual in a given area. To calculate demand, two essential components must be determined: the market area and its population composition, and the individual participation rate of each activity measured.

F.2.7. "The Plan Formulation and Evaluation Studies - Recreation," Volume II, US Army Corps of Engineers' Institute for Water Resources, postulates that an area that contributes 80 percent of the day-use visitation is defined as the market area. Using this postulate, an analysis of the 1971-1974 "Atchafalaya Basin Usage Study" (US Army Corps of Engineers and Louisiana Department of Wildlife and Fisheries) revealed a primary market influence zone of 45 miles. Thirteen parishes which fell wholly in this zone, together with some interpolative adjustments of seven partial bordering parishes, comprised the market area for the Atchafalaya Recreation Demand-Need Analysis. Additional available data on user characteristics of State Wildlife Management Areas in the market area, which were compiled and analyzed by the US Fish and Wildlife Service, and the Louisiana Department of Wildlife and Fisheries corroborated this market area determination. Parishes which make up the market area and their population projections for 1980 and 2030 are shown in Table F-2-1. Populations for the market area parishes were extracted from Bureau of Economic Analysis and Economic Research Service (OBERS) Projections, Series E 1972, and are shown by parish and the state planning region in which that parish lies.

F.2.8. The 1977 SCORP was used to identify participation rates for each of 21 recreational activity types. Only recreational activities which could be provided on the project were elected from the SCORP for this analysis. The State of Louisiana, through a statewide demand survey, measured high quarter recreational preferences (per capita participation rate) by regions and compared these expressions with the known supply of activities to determine need by activity type. The high quarter participation rates for each activity type were modified during consultation and concurrence by the Louisiana Department of Culture, Recreation and Tourism, through its Office of Program Development. These rates were modified to reflect the determined market area. With the 45-mile radius of the Atchafalaya market area as the outer boundary, Louisiana State Planning Regions 2, 3, 4, and 6 are transected. The adjusted market area participation rates were calculated by determining the proportion of the population of each planning region which lies in the market area, and weighing the market area participation rate by that percentage. This rate reflects the demand of the 45-mile market area with respect to its population as adjusted for both 1980 and 2030.

TABLE F-2-1

ATCHAFALAYA BASIN STUDY MARKET AREA - POPULATION PROJECTIONS BY PARISH AND STATE PLANNING REGIONS FOR 1980 AND 2030

State Planning Region	Parish	1980	2030
2	Ascension	42,446	45,293
	East Baton Rouge	327,291	390,168
	Iberville	31,767	33,898
	Livingston	46,315	49,421
	Pointe Coupee	22,540	24,052
	West Baton Rouge	18,476	19,715
	West Feliciana	8,782	9,371
	Subtotal	497,617	571,918
3	Assumption	20,927	22,331
	Lafourche	38,186	40,747
	St. James	20,099	21,448
	Terrebonne	43,605	46,529
	Subtotal	122,817	131,055
4	Acadia	51,999	44,606
	Evangeline	31,638	27,139
	Iberia	60,843	51,882
	Lafayette	128,487	145,666
	St. Landry	78,812	67,606
	St. Martin	33,628	28,846
	St. Mary	59,526	51,062
	Vermilion	43,499	37,313
	Subtotal	488,432	454,120
6	Avoyelles	37,893	28,715
	TOTAL	1,146,759	1,185,808

F.2.9. Participation rates for hunting activities were supplied by the US Fish and Wildlife Service (USFWS). These rates were determined by first projecting the average number of man-days engaged in by each hunter as recorded in the 1975 USFWS "Hunting and Fishing Survey for Louisiana," then multiplying the average hunter man-days by the number of licensed hunters residing in the market area. The resulting number is expressed as a participation rate of the total population of the market area and can be applied directly to the demand equation.

F.2.10. Once calculated, the market area population and market area participation rates for each activity are multiplied together to yield the gross demand figure for the activity as measured in activity occasions for the high quarter of the year, except for hunting, which is measured by hunting season. These are the periods in which demand is greatest.

F.2.11. Although gross demand in activity occasions was determined according to the basic procedure as outlined, several factors were developed as integral parts of the equation to more realistically define the degree and proportions of demand that can be satisfied within the market area. It is the application of these factors to the equation that reduces gross demand stated in units of activity occasions to net demand stated in units of resource facilities. This transition is necessary to make the ultimate comparison between demand and supply to determine need in facility requirements.

F.2.12. The first adjusting factor is the high quarter day. The high quarter demands were divided by 91.5 days (the number of days in the quarter) to measure the average daily demand that occurs in the peak season of use. A facility use over a year will vary widely; however, by planning for high quarter daily demands, the assumption is made that the facilities provided to satisfactorily accommodate this level of visitation will be more than adequate to handle the visitation that would occur during the remainder of the year. A high quarter day was not calculated for hunting activities because hunting carrying capacities are expressed over a hunting season (its high quarter) on a sustained yield harvest by varying land-use and habitat types.

F.2.13. The facility standard measures that amount of use a facility should receive under optimal conditions. These standards, as applied to the demand equation, are general guides that determine the number of facilities to be developed. The facility standards in the 1977 Louisiana SCORP were modified for use in this study after consultation with and agreement by the Louisiana Department of Culture, Recreation and Tourism, and the US Army Corps of Engineers, to more nearly reflect the type of facility developments that could be expected in the project area. The US Army Corps of Engineers' guidelines, "Heritage, Conservation and Recreation Service (HCRS) Outdoor Recreation Space Standards," and the Texas and Arkansas SCORP standards provided additional sources of comparison in the derivation of the modified facility standards as shown on Table F-2-2.

TABLE F-2-2

FACILITY USE STANDARDS AND MODIFICATIONS

WATER-ORIENTED ACTIVITY STANDARDS

Power boating:
Assume 4 persons/boat/launching lane
Turnover Rate = 16 (Launches and retrievals)
= 64 User-days (ud)/launching lane

Waterskiing:
Assume 4 persons/boat/launching lane
Turnover Rate = 16 (Launches and retrievals)
= 64 ud/launching lane

Nonpower boating:
Assume 2.25 persons/boat/launching lane
Turnover Rate = 16 (Launches and retrievals)
= 36 ud/launching lane

Boatfishing (fresh, salt):
Assume 2.5 persons/boat/launching lane
Turnover Rate = 20 (Launches and retrivals)
= 50 ud/launching lane

Bankfishing (piers):
Assume 1 person/10 linear feet of pier
Turnover Rate = 2
= 2 ud/10 linear feet

Bankfishing (other):
Assume 48 persons/mile of bank
Turnover Rate = 3
= 1 ud/36 linear feet

Crabbing:
Assume 1 person/80 linear feet of right-of-way
Turnover Rate = 1
= 1 ud/80 linear feet

Crawfishing:
Assume 1 person/266 linear feet of right-of-way
Turnover Rate = 1
= 1 ud/266 linear feet

Swimming:
Assume 1 person/9 square yards of water and 9 square yards of land
Turnover Rate = 2
= 2 ud/9 square yards of water and 9 square yards of land

TABLE F-2-2
(Continued)

FACILITY USE STANDARDS AND MODIFICATIONS

WATER ORIENTED ACTIVITY STANDARDS MODIFICATION

The daily time of launch lane use for power boating (Activity A), water skiing (Activity B), and non-power boating (Activity C) is generally from 10:00 a.m. to 6:00 p.m. whereas for boatfishing (Activity D), use occurs generally from 5:30 a.m. to 12:00 noon, and from 4:00 p.m. to 7:30 p.m. Use of launch lanes for Activity D between 12:00 p.m. and 4:00 p.m. is generally nil. During this time frame, launch lane use can be applied to Activities A, B, and C to minimize lanes needed as shown in the following steps:

1. Calculate total lane need for Activity D

2. Calculate total lane need for Activities A, B, and C.

3. Divide total lane need for Activity D by 2 as each lane for Activity D will support one-half of the daily need for Activities A, B, and C. (4 hours of non-use between 12:00 p.m. and 4:00 p.m. by Activity D equals one-half of 8 hours per day needed for Activities A, B, and C.)

4. Subtract the number derived in step 3 from the Activity A, B, and C total need.

5. Add steps 1 and 3 to arrive at total net lane need.

EXAMPLE

Assume 20 lanes needed for Activity D
Assume 10 lanes needed for Activity B
Assume 10 lanes needed for Activity A
Assume 4 lanes needed for Activity C

According to the 5 steps of the formula:

1. 20 lanes
2. 24 lanes
3. 20 lanes $\div$ 2 = 10 lanes
4. 24 - 10 = 14 net lanes for Activities A, B, and C
5. 20 + 14 = 34 total lanes needed for all activities combined

LAND-ORIENTED ACTIVITY STANDARDS

Bicycle trails:
Assume 10 persons/trail mile
Turnover rate = 3
= 30 ud/trail mile
Optimum Trail Length = 10 - 15 miles

TABLE F-2-2
(Continued)

FACILITY USE STANDARDS AND MODIFICATIONS

Birdwatching:
Assume 10 persons/trail mile
Turnover rate = 4
= 40 ud/trail mile
Optimum Trail Length = 1/4 - 1 mile

Tent camping:
Assume 4 persons/site
Turnover rate = 1
= 4 ud/site

Trailer camping:
Assume 4 persons/site
Turnover rate = 1
= 4 ud/site

Hiking trail:
Assume 5 persons/trail mile
Turnover rate = 4
= 20 ud/trail mile
Optimum Trail Length = 1 - 5 miles

Horse trails:
Assume 10 persons/trail mile
Turnover rate = 2
= 20 ud/trail mile
Optimum Trail Length = 5 - 20 miles

Nature walk:
Assume 10 persons/trail mile
Turnover rate = 4
= 40 ud/trail mile
Optimum Trail Length = 1/4 - 1 mile

Picnicking:
Assume 3.85 persons/site
Turnover rate = 2
= 7.7 ud/site

Multi-use field:[1/]
Assume 20 persons/game field
Turnover rate = 1.5
= 30 ud/field

[1/] Multi-use fields are used for softball, baseball, soccer, football, and for any other organized or unorganized activity which requires an open field (i.e., frisbee, kite flying, etc.).

TABLE F-2-2
(Continued)

FACILITY USE STANDARDS AND MODIFICATIONS

Multi-use court:
Assume 10 persons/court
Turnover rate = 2
= 20 ud/court

Playground:
One child's playground provides 5,378 days[2/] of opportunity per year.
0.53 = percent of total use which occurs in the summer
Then: 5,378 x .53 = 2,850.34 ÷ 91.5 days in the quarter = 31.15
= 31 ud/playground

[2/] Texas SCORP

F.2.14. Applying the preceeding adjustment factors, demand in activity occasions can now be expressed in average high-quarter day demand by resource or facility units for all activities except hunting, which will be expressed in man-days.

F.2.15. Demand in itself is a general expression and its specific associations to the market area can be vague unless properly defined. Two additional factors to accomplish this task were developed.

F.2.16. One factor relates to public versus private satisfaction of demand. Demand responses in the 1977 SCORP demand survey do not account for the level of an activity which will occur at exclusive sites not open to the public, even for a fee, such as private swimming pools or tennis courts at apartment complexes that are available to the tenants. This type of facility does satisfy some demand. The degree of demand satisfaction should be apportioned to determine the demand for public facilities. In this study effort, each activity was analyzed to determine the percent or level of demand which should then be satisfied by public facilities development. These percentages are shown in Tables F-2-3 and F-2-4. It should be remembered that both the demand for and supply of such facilities does not necessitate public ownership but includes those commercial operations that are available to the public on a fee (commercial) basis.

F.2.17. Not all recreation demand can or should be satisfied within a particular market area for several reasons. The public has diverse recreational interests and tends to satisfy its recreational demands at various locations that may be near or distant from the place of origin. In addition, certain recreational pursuits may be engaged in only where the source of supply exists, such as on larger water bodies for deep sea fishing or in the mountains for snow skiing. As a result, a factor was designed to measure the amount of demand that should be provided to satisfy the potential user within a geographic context. By analyzing each activity, respective percentages were derived that would reduce overall demand levels to that amount which is desired and could be satisfied in the market area, and not elsewhere in the State of Louisiana or elsewhere in the United States. These percentages are shown in Tables F-2-3 and F-2-4.

F.2.18. Conversely, a factor to measure the demand from outside the market area to be met in the market area was applied to the demand equation. This beyond the market area factor is based upon the original postulate that the market area population contributes only 80 percent of the total demand. The 20 percent beyond the market area factor is represented as 0.8 in Tables F-2-3 and F-2-4.

TABLE F-2-3

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION
YEAR 1980

Activity Type	Market Area 1980 Population	Market Area Participation Rate	Market Area High Quarter Activity Occasions	Market Area Days In High Quarter	Market Area High Quarter Day	Facility Standard	Gross Market Demand	Percent to Be Met In Market Area	Percent to Be Met In Public Area	Beyond Market Area Factor	Net Market Demand	Market Area Supply	Net Market Area Need
Land-Oriented													
1. Bicycling	1,146,759	7.77	8,910,317	91.5	97,381	30 ud/trail Mile trail length 10-15 mi.	3,246	50	99	0.8	2,008	0.85	2,007.15 trail miles
2. Birdwatching	1,146,759	2.17	2,488,467	91.5	27,196	40 ud/trail Mile trail length 1-5 mi.	680	85	36	0.8	260		
3. Camping, tent	1,146,759	3.19	3,658,161	91.5	39,980	4 ud/site	9,995	90	55	0.8	6,184	411	5,773 sites
4. Camping, trailer	1,146,759	1.04	1,192,629	91.5	13,034	4 ud/site	3,259	85	55	0.8	1,904	2,616	-712 sites
5. Hiking	1,146,759	1.06	1,215,565	91.5	13,285	20 ud/trail Mile trail length - 4 mi	664	100	70	0.8	581	10.5	570.5 trail miles
6. Horseback riding	1,146,759	1.35	1,548,125	91.5	16,919	20 ud/trail Mile trail length - 6 mi.	846	85	95	0.8	854	4	850 trail miles
7. Nature walk	1,146,759	1.96	2,247,648	91.5	24,564	40 ud/trail Mile trail length - 1 mi.	614	95	90	0.8	656	28.8	627.2 trail miles
8. Picnicking	1,146,759	2.30	2,637,546	91.5	28,826	7.7 ud/site	3,744	85	85	0.8	3,381	2,704	677 sites
9. Multi-use field	1,146,759	3.41	3,910,448	91.5	42,737	30 ud/field	1,425	95	99	0.8	1,675	796	879 fields
10. Multi-use court	1,146,759	2.62	3,004,509	91.5	32,836	20 ud/court	1,642	50	99	0.8	1,016	709	307 courts
11. Sightseeing	1,146,759	7.22	8,279,600	91.5	90,487	None	-	65	35	0.8	-	-	-
12. Playground	1,146,759	2.00	2,293,518	91.5	25,066	31 ud/playground	809	100	99	0.8	1,001	259	742 playgrounds
Water-Oriented													
1. Boating, power	1,146,759	5.84	6,697,073	91.5	73,192	64 ud/lane	1,144	60	80	0.8	686 (416)[1/]	96	320 lanes
2. Boating, nonpower	1,146,759	0.33	378,430	91.5	4,136	36 ud/lane	115	90	40	0.8	52 (32)[1/]	7	25 lanes
3. Boatfishing, fresh	1,146,759	5.24	6,009,017	91.5	65,672	50 ud/lane	1,313	60	70	0.8	689	242	447 lanes
4. Boatfishing, salt	1,146,759	2.39	2,740,754	91.5	29,954	50 ud/lane	559	60	70	0.8	90		
5. Bankfishing, fresh	1,146,759	1.03	1,181,161	91.5	12,909	2 ud/10 lin. ft. pier 1 ud/36 lin. ft. bank	64,545 464,724	85	85	0.8	58,293 pier 419,704 bank		
6. Crabbing	1,146,759	2.03	2,327,921	91.5	25,442	1 ud/80 lin. ft.	385 mi.	90	50	0.8	217		
7. Crawfishing	1,146,759	2.45	2,809,560	91.5	30,706	1 ud/266 lin. ft.	1,547 mi.	90	95	0.8	1,653		
8. Swimming, lake	1,146,759	1.50	1,720,139	91.5	18,799	2 ud/9 sq. yds. land and water	169,192 sq. yds.	90	99	0.8	1,586,167 sq. feet	1,643,468	-57,301 sq. feet
9. Waterskiing	1,146,759	1.13	1,295,838	91.5	14,162	64 ud/lane	221	60	80	0.8	132 (79)[1/]	18	61 lanes

[1/] Boat lanes demanded as shown in parentheses represent a more refined, weighted demand that represents overlapping use for related activities, as explained in Facility Use Standards and Modifications (Table F-2-2).

TABLE F-2-4

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION
YEAR 2030

Activity Type	Market Area 2030 Population	Market Area Participation Rate	Market Area High Quarter Activity Occasions	Market Area Days In High Quarter	Market Area High Quarter Day	Facility Standard	Gross Market Demand	Percent to Be Met In Public Area	Percent to Be Met In Market Area	Beyond Market Area Factor	Net Market Demand	Market Area Supply	Net Market Area Need
Land-Oriented													
1. Bicycling	1,185,808	7.79	9,237,444	91.5	100,956	30 ud/trail mile trail length 10-15 mi.	3,365	50	99	0.8	2,082	0.85	2,081.15 trail miles
2. Birdwatching	1,185,808	2.31	2,739,216	91.5	29,937	40 ud/trail mile trail length 1-5 mi.	748	85	36	0.8	286		
3. Camping, tent	1,185,808	3.06	3,628,572	91.5	39,657	4 ud/site	9,914	90	55	0.8	6,135	411	5,724 sites
4. Camping, trailer	1,185,808	1.06	1,256,956	91.5	13,737	4 ud/site	3,434	85	55	0.8	2,006	2,616	-610 sites
5. Hiking	1,185,808	1.02	1,209,524	91.5	13,219	20 ud/trail mile trail length - 4 mi.	661	100	70	0.8	578	10.5	567.5 trail miles
6. Horseback riding	1,185,808	1.32	1,565,267	91.5	17,107	20 ud/trail mile trail length - 6 mi.	855	85	95	0.8	719	4	715 trail miles
7. Nature walk	1,185,808	2.03	2,407,190	91.5	26,308	40 ud/trail mile	658	95	90	0.8	703	28.8	674.2 trail miles
8. Picnicking	1,185,808	2.32	2,751,075	91.5	30,066	7.7 ud/site	3,905	85	85	0.8	3,527	2,704	823 sites
9. Multi-use field	1,185,808	3.58	4,245,193	91.5	46,396	30 ud/field	1,547	95	99	0.8	1,819	796	1,023 fields
10. Multi-use court	1,185,808	2.70	3,201,681	91.5	34,991	20 ud/court	1,750	50	99	0.8	902	709	193 courts
11. Sightseeing	1,185,808	7.26	8,608,966	91.5	94,087	None	-	65	35	0.8	-	-	-
12. Playground	1,185,808	2.06	2,442,764	91.5	26,697	31 ud/playground	861	100	99	0.8	1,066	259	807 playgrounds
Water-Oriented													
1. Boating, power	1,185,808	5.59	6,628,667	91.5	72,444	64 ud/lane	1,132	60	80	0.8	679 (399)[1/]	96	303 lanes
2. Boating, nonpower	1,185,808	0.30	355,742	91.5	3,888	36 ud/lane	108	90	40	0.8	49 (49)[1/]	7	42 lanes
3. Boatfishing, fresh	1,185,808	5.26	6,237,350	91.5	68,168	50 ud/lane	1,363	60	70	0.8	716	242	474 lanes
4. Boatfishing, salt	1,185,808	2.30	2,727,358	91.5	29,807	50 ud/lane	596	60	20	0.8	90		
5. Bankfishing, fresh	1,185,808	1.00	1,185,808	91.5	12,960	2 ud/10 lin. ft. pier 1 ud/36 lin. ft. bank	64,800 466,560	85	85	0.8	58,522 pier 421,363 bank		
6. Crabbing	1,185,808	1.96	2,324,184	91.5	25,401	1 ud/80 lin. ft.	385	90	50	0.8	217		
7. Crawfishing	1,185,808	2.36	2,798,507	91.5	30,585	1 ud/266 lin. ft.	1,540	90	95	0.8	1,646		
8. Swimming, lake	1,185,808	1.49	1,766,854	91.5	19,310	2 ud/9 sq. yds. land and water	173,790	90	99	0.8	1,742,027	1,643,468	98,559 sq. feet
9. Waterskiing	1,185,808	1.11	1,316,247	91.5	14,385	64 ud/lane	225	60	80	0.8	135 (76)[1/]	18	58 lanes

[1/] Boat lanes demanded as shown in parentheses represent a more refined, weighted demand that represents overlapping use for related activities, as explained in Facility Use Standards and Modifications (Table F-2-2).

F.2.19. By employing all the aforementioned applied factors, gross demand has been translated into a net figure that measures demand for public outdoor recreational facilities by all individuals who live in or travel into the market area to recreate.

SUPPLY

F.2.20. Market area supply data used in the demand need analysis were obtained from two basic sources: the Louisiana SCORP "1980 Recreational Inventory" and "Land Use Projections," which were cooperatively prepared by the USFWS and Louisiana Department of Wildlife and Fisheries.

F.2.21. The Louisiana SCORP provided both public and commercial supply data for recreational activities other than hunting. Market area supply data, in the form of recreational resources by facility type (i.e., picnic site, campsite, boat launch lane), were available for 15 recreational activities. Supply data for seven activities, which included saltwater fishing, freshwater bankfishing, crabbing, crawfishing, birdwatching, sightseeing, and waterfowl hunting, were not available, but an expressed demand for these activities was reflected in the Louisiana SCORP Demand Survey. Supply data for 2030 could not be forecast for nonconsumptive recreational activities. Existing supply figures were used to calculate future needs.

F.2.22. Both public and private hunting supply data were projected in terms of existing and future land use (Tables F-2-5 and F-2-6). Huntable acreage by major habitat type for each parish in the market area was converted to man-days of supply, based upon habitat carrying capacities (biological harvest rate) in man-days per acre (Tables F-2-7 and F-2-8). The conversion to man-days of supply with respect to hunting was to facilitate the translation of the final need figures into acreage requirements for any of the 10 habitat types available for public use.

F.2.23. Large numbers of migratory waterfowl overwinter in the market area; but, because of their mobility, these birds could overwinter in suitable habitat that is presumably available elsewhere. Wintering habitat was not assumed to be a factor limiting migratory waterfowl hunting opportunities. Furthermore, the recognized inclination of waterfowl hunters to travel great distances in pursuit of this form of recreation negates the possibility of using the concept (previously described) of satisfying a given percentage of the demand within the market area. Wood ducks and mottled ducks, however, commonly nest in the market area and any fluctuation in available breeding habitat is expected to directly influence these species and the harvestable surplus that could be produced in the market area. Any gain or loss of habitat would cause a fluctuation in the harvestable population of

TABLE F-2-5

ATCHAFALAYA BASIN STUDY
SUPPLY ACREAGE - MARKET AREA
ALL HABITAT TYPES - YEAR 1980

Habitat Type	Public (Acres)	Private (Acres)	Total (Acres)
Bottomland Hardwoods	145,000	1,187,890	1,332,890
Cypress-Tupelo	0	1,000,145	1,000,145
Upland Pine	0	37,100	37,100
Cottonwood/Willow/ Sycamore	65,000	27,045	92,045
Pine	0	475,200	475,200
Cleared Land	0	2,439,481	2,439,481
Fresh Marsh	20,500	413,739	434,239
Intermediate Marsh	0	138,640	138,640
Brackish Marsh	0	302,977	302,977
Saline Marsh	0	118,751	118,751

The land change rate used to calculate marsh habitat type acreages in the recreational demand-need analysis was updated subsequent to this analysis but the total impact of not using that updated rate is less than 1/10 of 1 percent.

TABLE F-2-6

ATCHAFALAYA BASIN STUDY
SUPPLY ACREAGE - MARKET AREA
ALL HABITAT TYPES - YEAR 2030

Habitat Type	Public (Acres)	Private (Acres)	Total (Acres)
Bottomland Harwoods	157,000	542,845	699,825
Cypress-Tupelo	0	763,055	763,055
Upland Pine	0	37,100	37,100
Cottonwood/Willow/ Sycamore	53,000	2,290	55,290
Pine	0	475,200	475,200
Cleared Land	0	3,309,636	3,309,636
Fresh Marsh	46,964	405,687	452,651
Intermediate Marsh	0	114,253	114,253
Brackish Marsh	0	266,820	266,820
Saline Marsh	0	56,912	56,912

The land change rate used to calculate marsh habitat type acreages in the recreational demand-need analysis was updated subsequent to this analysis but the total impact of not using that updated rate is less than 1/10 of 1 percent.

The total supply acreage loss which occurs from 1980 to 2030 can be attributed to marsh converting to open water as a result of subsidence, saltwater intrusion and curtailment of sediment flow which renourishes the marshes.

TABLE F-2-7

ATCHAFALAYA BASIN STUDY
MARKET AREA MAN-DAYS OF HUNTING SUPPLY
(Man-days/Acre x Acres = Man-days) by
ACTIVITY TYPE FOR ALL HABITAT TYPES - YEAR 1980

Habitat Type	Big Game (public)	Big Game (private)	Small Game (public)	Small Game (private)	Waterfowl[1/] (public)	Waterfowl[1/] (private)
Bottomland Hardwoods	78,155	248,269	34,655	199,566	725	3,564
Cypress-Tupelo	0	77,102	0	72,010	0	5,001
Upland Pine	0	5,565	0	3,562	0	74
Cottonwood/Willow/ Sycamore	13,585	3,354	6,435	1,460	520	81
Pine	0	58,925	0	39,917	0	475
Cleared Land	0	0	0	102,458	0	0
Fresh Marsh	349	7,034	2,235	45,098	41	827
Intermediate Marsh	0	1,109	0	15,112	0	416
Brackish Marsh	0	0	0	22,117	0	303
Saline Marsh	0	0	0	2,850	0	0
Total	92,089	401,268	43,325	504,150	1,286	10,741

[1/]Resident Waterfowl Production Capacity - the estimated number of waterfowl produced per acre per year by habitat type and expressed as man-days/acre of hunting capacity.

TABLE F-2-8

ATCHAFALAYA BASIN STUDY
MARKET AREA MAN-DAYS OF HUNTING SUPPLY
(Man-days/Acre x Acres = Man-days) by
ACTIVITY TYPE FOR ALL HABITAT TYPES - YEAR 2030

Habitat Type	Big Game (public)	Big Game (private)	Small Game (public)	Small Game (private)	Waterfowl[1/] (public)	Waterfowl[1/] (private)
Bottomland Hardwoods	84,623	113,450	37,523	91,195	785	1,628
Cypress-Tupelo	0	58,755	0	54,940	0	3,815
Upland Pine	0	5,565	0	3,562	0	74
Cottonwood/Willow/ Sycamore	11,077	284	5,247	124	265	7
Pine	0	58,925	0	39,917	0	475
Cleared Land	0	0	0	139,005	0	0
Fresh Marsh	798	6,897	5,119	44,220	94	811
Intermediate Marsh	0	914	0	12,454	0	343
Brackish Marsh	0	0	0	19,478	0	267
Saline Marsh	0	0	0	1,366	0	0
Total	96,498	244,790	47,889	406,261	1,144	7,420

[1/] Resident Waterfowl Production Capacity - the estimated number of waterfowl produced per acre per year by habitat type and expressed as man-days/acre of hunting capacity.

these species and in the supply of recreational opportunity associated with this harvestable segment (D. Soileau, USFWS, personal communication). Accordingly, the gain or loss in recreational potential from these species was computed and is measured in man-days of supply as shown in Tables F-2-7 and F-2-8.

NEEDS

F.2.24. Market area needs were obtained by subtracting the market area supply for each recreational activity type from the net market area demand for each recreational activity type. A positive net need indicates that recreational development to accommodate existing and future use is justifiable on the basis of demand and warrants consideration. In the case of the seven recreational activities where demand is expressed but no supply figure could be ascertained, minimal development for that activity type can be considered. A negative need indicates a market area surplus, and careful consideration should be exercised in providing similar additional facilities.

F.2.25. Needs for all recreational activities other than hunting have been stated in terms of recreational resource facility needs. Hunting needs for big game and small game hunting have been stated in terms of bottomland hardwood acreage because this is the prime habitat type for both big and small game species, and as such would offer the highest use capability. It should be pointed out, however, that a conversion to need acreage figures for any habitat type can be easily accomplished by dividing man-days of need (Tables F-2-9 and F-2-10), by the respective habitat carrying capacity (Table F-2-11).

F.2.26. It should be noted that a needs analysis is intended to ascertain general supply-demand relationships for the project market area. The analysis was regional in nature and was intended as a tool to identify alternative types of facility development possibilities for the project. It should not be inferred that all needs for the parishes in the market area be met at the project, which, of course, would ignore needs in other portions of these parishes.

SUMMARY

F.2.27. The needs analysis of the market area shows an overall deficit in recreational needs for all land and water-based recreational activities considered except recreational vehicle or trailer camping, which exhibit a market area surplus. This surplus is predicated on within-state usage and may require additional considerations for minimum facility development based upon the increasing national attraction to the project.

TABLE F-2-9

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION FOR HUNTING ACTIVITIES
YEAR 1980

Activity Type	Market Area Population	Market Area Participation Rate	Percent to be met in Market Area	Beyond Market Area Factor	Percent to be met in Public Area	Percent to be met in Private Area	Gross Market Demand in Man-days	Public Supply in Man-days	Private Supply in Man-days	Public Need in Man-days	Private Need in Man-days	Hunting Carrying Capacity Bottomland Hardwoods	Acres of Net Market Area Need Bottomland Hardwoods
Big Game, public	1,146,759	0.635	81	0.8	34.1		251,417	92,089		159,328		0.539	295,599
Big Game, private	1,146,759	0.635	81	0.8		65.9	485,877		401,268		84,609	0.209	404,828
Small Game, public	1,146,759	1.154	85	0.8	41.6		584,925	43,325		541,600		0.239	2,266,109
Small Game, private	1,146,759	1.154	85	0.8		58.4	821,145		504,150		316,995	0.168	1,886,875

TABLE F-2-10

ATCHAFALAYA BASIN STUDY
RECREATION DEMAND - NEED EQUATION FOR HUNTING ACTIVITIES
YEAR 2030

Activity Type	Market Area Population	Market Area Participation Rate	Percent to be met in Market Area	Beyond Market Area Factor	Percent to be met in Public Area	Percent to be met in Private Area	Gross Market Demand in Man-days	Public Supply in Man-days	Private Supply in Man-days	Public Need in Man-days	Private Need in Man-days	Hunting Carrying Capacity Bottomland Hardwoods	Acres of Net Market Area Need Bottomland Hardwoods
Big Game, public	1,185,808	0.635	81	0.8	34.1		259,979	96,498		163,481		0.539	303,304
Big Game, private	1,185,808	0.635	81	0.8		65.9	502,422		244,790		257,632	0.209	1,232,689
Small Game, public	1,185,808	1.154	85	0.8	41.6		604,843	47,889		556,954		0.239	2,330,351
Small Game, private	1,185,808	1.154	85	0.8		58.4	849,106		406,261		442,845	0.168	2,635,982

TABLE F-2-11

ATCHAFALAYA BASIN STUDY
HUNTING CARRYING CAPACITIES - MARKET AREA
ALL HABITAT TYPES IN MAN-DAYS/ACRE

Habitat Type	Big Game (public)	Big Game (private)	Small Game (public)	Small Game (private)	Waterfowl[1/] (public)	Waterfowl[1/] (private)
Bottomland Hardwoods	0.539	0.209	0.239	0.168	0.005	0.003
Cypress-Tupelo	0.113	0.077	0.072	0.072	0.006	0.005
Upland Pine	0.249	0.150	0.124	0.096	0.002	0.005
Cottonwood/Willow/ Sycamore	0.209	0.124	0.099	0.054	0.005	0.003
Pine	0.207	0.124	0.139	0.084	0.001	0.001
Cleared Land	0.252	0	0.154	0.042	0.002	0
Fresh Marsh	0.017	0.017	0.109	0.109	0.002	0.002
Intermediate Marsh	0.008	0.008	0.109	0.109	0.003	0.003
Brackish Marsh	0	0	0.073	0.073	0.001	0.001
Saline Marsh	0	0	0.024	0.024	0	0

[1/] Resident Waterfowl Production Capacity - the estimated number of waterfowl produced per acre per year by habitat type and expressed as man-days/acre of hunting capacity.

F.2.28. Market area recreation demand and usage patterns appear to be closely associated with the existing resource base and the more traditional uses or recreational activities that occur on that resource (i.e., fishing and hunting).

F.2.29. The large amounts of privately-owned land do provide for much of the hunting activity in the market area; however, it is difficult to assess the degree of use and demand satisfaction that they provide.

F.2.30. Water-based recreation provides the greatest potential for use in the market area. Fishing, crawfishing, and crabbing are additional examples of traditional recreational activities that are popularly pursued and which are not as restricted by access. Existing facilities to accommodate water-oriented recreational activities are limited. Many facilities are in poor condition or lacking, particularly well located, developed boat-launching ramps.

F.2.31. There are several nature-oriented activities that have increased in national popularity in recent years. The pursuit of many of these activities, which includes hiking, backpacking, nature study, wildlife photography, and birdwatching, is minimized in the basin because of limited access caused by extensive private land ownership, the relative nonavailability of public land, and the lack of developed support facilities. These are the major problems that have adversely impacted the Atchafalaya Basin and reduced its viability in satisfying both the land and water-based recreational demands of the public.

Section 3 - RECREATION DEVELOPMENT PLAN

OVERVIEW OF TENTATIVELY SELECTED AND RECOMMENDED PLANS

F.3.1. The recommended recreation plan for the Atchafalaya Basin Study has been developed with two main objectives:

- Optimize public accessibility and use of the floodway
- Minimize adverse impacts on the existing biological and physical environment.

F.3.2. The multipurpose nature of the project affords the opportunity to provide for public recreational facility development; however, certain inherent constraints within the floodway prevent optimized development. Among the most significant constraints are the flood-prone nature of the basin, the dispersed local population, the limited vehicular access, and extensive private landholdings. Adding to these constraints is the degree to which a local sponsor would be willing and able to ultimately operate and maintain any developed recreational facilities.

F.3.3. With these objectives and constraints considered, a plan was developed that would satisfy a proportion of the public demand for outdoor recreation within the project market area and yet minimize overall land acquisition and development within the floodway.

F.3.4. The initially developed recreation features of the tentatively selected (TS) plan described in this appendix relied heavily on acquisition of public access easements in the basin. Subsequent to the July 1981 public meetings, an alternative proposal was formulated by the State of Louisiana which, if implemented, would comparably replace the public access feature of the TS plan to which public objections were raised. This feature has been analyzed and is recommended in lieu of that feature of the TS plan. Both plans are presented in this appendix in order to provide a degree of continuity in the various stages of report preparation and to further serve in providing a basis of comparison. A description of the recommended plan is detailed in paragraphs F.3.11. through F.3.16. A comparative analysis of the effects of this alternative feature in terms of annual use and recreation benefits is provided at the end of Sections 5 and 6 of this appendix.

THE TENTATIVELY SELECTED PLAN

F.3.5. The TS plan proposed the combined use of fee purchase and comprehensive multipurpose easement to guarantee public access to

about 40 percent of the floodway's acreage. This includes access to approximately 150,000 acres already in public ownership and to an additional 105,000 acres to which access would be acquired under this plan. Such access would increase the viability of public recreational use of the floodway, which has previously been minimal when compared with private use.

F.3.6. In general, the classification and/or use of the 105,000 acres considered for access under the TS plan is summarized as follows:

50,000	Acres of cypress-tupelo
30,000	Acres of bottomland hardwoods
23,000	Acres of greenbelts
500	Acres of rookeries
1,500	Acres of campgrounds, boat launching areas, and special and unique areas
105,000	Total acres to which access would be acquired.

F.3.7. The 50,000 acres of cypress-tupelo would be preserved and maintained in as near a natural state as possible. Development would be minimal. Access would allow the public to view the beauty and uniqueness of this wilderness swamp, which is its greatest attraction. Cypress-tupelo swamps have the potential to support recreational activities, such as wildlife observation, nature study, and canoeing. Hunting also would be allowed, although its potential is greater in the hardwood areas.

F.3.8. The 30,000 acres of bottomland hardwoods would serve primarily as public hunting areas. No major development is envisioned for these areas. In addition to providing for various types of hunting, public access to these lands would offer opportunities for nonconsumptive recreation, such as hiking or nature study.

F.3.9. Greenbelts encompassing 23,000 acres would provide access to land areas for recreational purposes along 300-foot wide strips on each side of public navigable waters and to selected land areas inside and adjacent to floodway protection levees, which are one-fourth mile or less from the water. Aside from protecting the esthetics and enhancing the natural outdoor experience by providing scenic buffers, these greenbelts would allow members of the public to pursue such activities as crawfishing, bankfishing, making overnight canoe trips, hiking, and camping. The flood-prone nature of these greenbelt areas precludes most recreational facilities developments; however, some facilities may be provided in designated areas less susceptible to flooding.

F.3.10. Rookeries are important because they serve as sanctuaries and propagation areas for many exotic bird species found in the basin floodway. These sensitive areas, totaling 500 acres, would only be

accessible on a very limited and controlled basis to recreationists who watch and photograph birds. Hunting would be restricted, and other forms of recreation would be subordinated to maintain the integrity and viability of the bird population.

THE RECOMMENDED PLAN

F.3.11. The recommended real estate plan which includes the amended public access feature proposal, utilizes fee purchase and donation to guarantee public access to about 39 percent of the floodway's acreage. This includes access to approximately 150,000 acres already in public ownership and to an additional 79,500 acres to which access would be acquired under this plan. Such access would increase public recreational use of the floodway, which has previously been minimal when compared with private use. Additionally, there are some 10,000 acres located east of the floodway to which access would be acquired under this plan but which are not comparatively analyzed or evaluated in the context of this study.

F.3.12. In general, the classification and/or use of the 79,500 acres under consideration for access is summarized as follows:

12,000	Acres of cypress-tupelo
48,000	Acres of bottomland hardwoods
18,000	Acres of early successional bottomland hardwoods
1,500	Acres of campgrounds, boat launching areas, and special and unique areas
79,500	Total acres to which access would be acquired.

F.3.13. The 12,000 acres of cypress-tupelo would be preserved and maintained in as near a natural state as possible. Development would be minimal. Access would allow the public to view the beauty and uniqueness of this wilderness swamp, which is its greatest attraction. Cypress-tupelo swamps have the potential to support recreational activities such as wildlife observation, nature study, and canoeing. Hunting also would be allowed, although its potential is greater in the hardwood areas.

F.3.14. The 48,000 acres of late successional bottomland hardwoods and 18,000 acres of early successional bottomland hardwoods would serve primarily as public hunting areas. No major development is envisioned for these areas. In addition to providing for various types of hunting, public access to these lands would offer opportunities for nonconsumptive recreation, such as hiking or nature study.

F.3.15. Major recreational facility development would be provided on 1,500 acres of land purchased in fee, either in or near the

floodway.[1/] The recommended use of the 1,500 acres is summarized as follows:

3	Developed campgrounds	600 acres
7	Primitive campgrounds	350 acres
1	Project visitor center	100 acres
8	Boat launching ramps (2 lanes)	80 acres
7	Boat launching ramps (5 lanes)	70 acres
1	Nature-interpretive trail	100 acres
	Special and unique areas	200 acres.

F.3.16. The acquisition and development of these areas would accommodate and support additional public use of the basin, provide for additional entry into the floodway and access to its resources, and protect and aid in interpreting specific environmentally and culturally significant resources.

FACILITY DESIGN CRITERIA

F.3.17. General. The number and types of facilities recommended for the various recreational areas are based principally on the projected recreational needs and the appropriateness of the facilities for the specific sites. Projected recreational use served as guides to the number of facilities rather than absolute dictates. The intent was to optimize anticipated recreational benefits while minimizing operation and maintenance costs. The design criteria are a composite of pertinent criteria in Engineering Regulation 1110-2-400, Engineering Manual 1110-2-400[2/], Louisiana State Parks Planning Guidelines, and the Red River Waterway Master Plan for Resources Development.

F.3.18. Siting. For each of the recreational facilities, the most advantageous locations were sought in view of site conditions and recreational needs. The intent has been to avoid construction limitations and environmental impacts, while simultaneously maximizing recreational opportunities.

F.3.19. Frequent low-level flooding is a major siting limitation at nearly all recreation sites. Consequently, potentially affected

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[1/] Recreational facility development as stated is a recommended feature of all plan alternatives.

[2/] This Engineering Manual is currently under revision; however, at the time of this report the revised edition was not available.

facilities would be located above the 10-year flood level where possible. Structures located within the 100-year flood plain would be flood-proofed or designed of materials that can be easily cleaned and restored to operation after flooding. Sedimentation patterns are major constraints in the delineation of sites, as well as the specific location of boat-launching ramps. Other limitations are considered minor and would be mitigated during detailed siting construction.

F.3.20. Camping Areas. More than one type of camping would be provided in or near the floodway. Developed camping, which accommodates both tents and trailers, would require utility services and sanitary facilities. Primitive camping would require very little development. Specific requirements for developed and primitive camping are discussed subsequently.

F.3.21. Developed Camping. This is discussed as follows:

- Location

  Eastern solar exposure is preferable
  Isolated from rest of the recreation area.

- Layout

  Fifty site minimum facility, 100-200 sites desirable
  Five camping units per acre maximum
  Three hundred to 500 feet maximum distance to washhouse.

- Facilities

  RV impact pad and tent camping pad per unit with electrical hook-up
  Picnic table per unit, some designed for access by handicapped
  Fireplace or fire ring per unit
  Charcoal brazier per unit
  Parking space 10 by 25 feet minimum per unit
  Thirty-gallon anchored trash receptacle per two units
  Camping spurs, paved
  Water hydrants and fountain per 25 units
  Washhouse per 50 units
  One heated washhouse for winter use
  One well per 25 units within 300 feet of site where water system is not available
  Sanitary waste dumping station per 50 to 200 spaces
  All night lighting of sanitary facilities
  Water supply: for showers, 100 gallons per day per campsite; for toilets, 60 gallons per day per campsite; for drinking, 20 gallons per day per campsite.

F.3.22. Primitive Camping. Primitive camping areas would accommodate overnight use by canoeists and hikers at designated locations that are isolated. This would be accomplished by providing a limited number of areas having difficult access at remote locations, which are situated in an extensive high-quality natural setting along specific navigable streams.

- Location

  Large areas with high quality natural character
  Isolated location
  May include remote sites accessible by boat or trail only.

- Layout

  Fifty or less campsites desirable
  Two units per acre maximum
  Minimum of 100 feet between units
  Three to eight people per site.

- Facilities

  Central parking at trailhead or boat launch
  Fire circle per unit
  Trash receptacle at trailhead or boat launch
  Vault-type comfort station on site where feasible and/or when use dictates
  Hand pump well on site where feasible.

F.3.23. Day-Use Picnic Areas. Separate picnic facilities would be provided near the developed campgrounds and at specific boat launch areas.

- Layout and Space Requirements

  Minimum of five picnic tables per area
  Minimum area of 225 square feet per picnic site
  Maximum of 12 tables per acre.

- Facilities

  Concrete tables affixed to concrete impact areas
  One cooking grill or campfire circle per table
  Individual shelters for tables in areas without tree cover
  One trash receptacle per two tables
  Per picnic unit, 1.5 automobile parking spaces.

F.3.24. Boat-Launching Facilities. Boat-launching facilities have been planned to provide access to the river, lakes, bayous, and other

water bodies. Each launching ramp will contain a minimum of two launch lanes and would be designed to allow for future expansion.

- Location

  Short and easy access from site entry points and circulation roadways
  Consider localized current and sedimentation pattern
  Provide sufficient deep water area
  Site would offer protection from winds and waves.

- Boat Launching Lanes/Ramps

  Launching lane widths would be 12 feet, total ramp width would be in multiples of this width
  Upper limit of ramp would be 3 feet above the water stage that is equalled or exceeded two percent of time (2 percent flowline)
  Lower limit of ramp would be located 4 feet below the annual average low water elevation
  Minimum of 75-foot diameter vehicular turnaround
  Ramps would be surfaced in scored or patterned concrete that is reinforced or prestressed
  Ramp gradients would be between 13 and 15 percent
  Ramp shoulders would be stabilized to prevent erosion
  Six-inch curbs would be provided on both sides of the ramp
  Mercury vapor lighting on wooden poles would be located adjacent to boat ramps where feasible.

- Courtesy/Loading Dock

  One courtesy/loading dock would be constructed adjacent to the upstream side of each ramp
  Dock would be constructed of concrete with rough surface finish and slope at same gradient as the ramp.

- Parking

  Provide 25 car/trailer spaces per two launching lanes and 50 trailer spaces per five launching lanes.

F.3.25. Hiking Trails. Hiking and interpretive trails would be provided in conjunction with specific public use areas. All trails would be designed to take advantage of the recreational, esthetic, and interpretive potentials of the areas through which they pass. Trails would be designed to follow the contour of the topography in a natural manner. Short day-use trails would be 1 to 3 miles in length; long day-use loops would be 3 to 5 miles in length. Interpretive trails would normally be short, usually less than one mile.

- Clearing

  Tread width 3 feet minimum
  Clearing width 7 feet minimum
  Clearing height 7 feet minimum.

- Gradients

  Less than 10 percent.

- Surface

  Earth for low-usage areas, such as primitive camping.

- Signs

  Minimize number of signs
  Signs at trail heads with health and safety information, as well as length, route, and features
  Mileage markers
  Interpretive markers only where meaningful.

F.3.26. Washhouses. This is discussed as follows:

- Location

  In camping areas, one per 50 campsites.

- Size

  Approximately 810 square feet.

- Facilities

  Three toilets, three showers, and four lavatories for women; two toilets, one urinal, three showers, and four lavatories for men
  Water heater
  Water fountain on exterior wall near entrance
  Water spigot on exterior wall
  Half of washhouses in each campground will contain electrical heating system
  Five parking spaces
  Double laundry tub on exterior.

F.3.27. Picnic Shelter. This is discussed as follows:

- Location

  In major picnic areas at approximately one per 25 picnic sites.

- Size

  Approximately 580 square feet.

- Facilities

  Four charcoal braziers (adjacent), 4 picnic tables, and 2 refuse containers.

F.3.28. Control Station. This is discussed as follows:

- Location

  At selected access points to camping areas.

- Size

  Approximately 216 square feet.

- Facilities

  Space for vehicle backup, two vehicular lanes desirable
  Electric and telephone service
  One lavatory and one toilet.

F.3.29. Playgrounds. Playgrounds would be planned for each developed campground. For safety purposes, these would be located near adult activity areas. Generally, prefabricated play apparatus would be utilized. Innovative and naturalistic timber forms and materials are desirable.

- Location

  Open to partially open area
  In sight of camping or picnic areas
  Adjacent to play field
  Removed from general traffic patterns.

- Layout and Space Requirements

  Two to 3 acres.

- Facilities

  Play apparatus
  Benches for adults.

- Details

  Slides would be permanently installed
  Sand or bark surface.

- Gradient

  Location in relatively flat areas is desirable.

F.3.30. Playfields and Gamecourts. These multi-use facilities would be located adjacent to camping areas. A north-south orientation is desirable for all playfields and gamecourts.

F.3.31. Canoe Trails. Canoe trails would be provided along specific scenic navigable waters. Lengths of trails would vary; however, overnight use would be accommodated by primitive camping areas.

- Canoe Trail Signs

  Signs at trail heads with health and safety information, as well as length, route, and features
  Mileage markers
  Interpretive markers only where meaningful.

F.3.32. Structures (Comfort Station, Washhouses, Picnic Shelters). Structural treatment would emphasize use of native materials and an architectural style that would be compatible with the natural aspects of the region.

F.3.33. Comfort Station. This is discussed as follows:

- Size

  Approximately 450 square feet.

- Facilities

  To be of vandal-resistant and fire-resistant design
  Three toilets and 3 lavatories for women; 2 urinals, 1 toilet, and 2 lavatories for men
  Water fountain on exterior wall near entrance
  Water spigot on exterior wall
  Five parking spaces.

F.3.34. Playfields. This is discussed as follows:

- Layout

  Open or partially open fields, 2 to 3 acres in size where practical, cleared and seeded.

- Facilities

  Provide softball field outline and backstop 16 feet tall constructed of chain link, painted green.

F.3.35. Gamecourts. These are discussed as follows:

- Layout

  Open area of 8,000 square feet minimum.

- Facilities

  Provide appropriate number of courts with line delineating game spaces. Court would be surfaced with concrete and, where not subject to flooding have a 10-foot high chain link fence, painted green, around all sides.

- Gradient

  One inch in 10-foot optimum slope in direction of existing grade.

F.3.36. Fishing Piers. Fishing piers would be provided where feasible at developed campgrounds to accommodate use by campers. These would be designed to allow access for the handicapped.

- Location

  Short and easy access from campground or circulation roadways
  Extend over body of water having fishing potential.

- Size

  Approximately 20 feet long and 10 feet wide.

- Details

  Solid construction with pilings
  Guard rails
  Five parking spaces.

F.3.37. Roads. Park design speeds would generally be less than 30 mph. Rights-of-way clearing, cutting and filling, and use of roadway structures would be minimized. Circulation roadway design should be based on the standards delineated in EM 1110-2-400.

F.3.38. Parking Areas. Parking lot planning and design would minimize the visual impact of the automobile, serve the recreational activity from an appropriate distance, and preserve existing vegetation for shade and screening, and provide esthetic artificial or natural barriers along lot limits. Parking lots would be screened from roadways and all recreational activity areas. Situations, such as cars backing from parking spaces directly into circulation routes would be avoided. Swales and interceptor ditches would be utilized to control storm drainage.

- Layout and Space Requirements

  Car parking spaces 10 by 20 feet with 20-foot aisles
  Car-trailer parking spaces - 10 by 35 feet at 45-degree angle with 25-foot aisles
  Include area for overflow parking.

- Surface

  Bituminous paving or crushed stone as appropriate.

F.3.39. Wastewater Disposal. Wastewater, principally sewage, generated at recreation sites, would be treated and disposed of primarily through the use of septic tank systems, if the topography and soil conditions at the sites are conducive to soil matrix absorption and stabilization of sewage flows. Septic tank systems would include installation of concrete tank, distribution piping, and filter field. If septic tank systems are not feasible, package treatment units would be installed. Sites where package waste water treatment units are required would employ extended aeration package units on concrete pads with effluent piping, and discharge to the appropriate water body.

F.3.40. Wastewaters from drinking fountains would simply be allowed to run off untreated, following the natural drainage gradients surrounding their supporting structures as practiced at Louisiana State Park facilities. A gravel sump to handle water and prevent muddy conditions would be provided.

F.3.41. Refuse Disposal. Refuse generated at recreation sites would be collected in trash receptacles provided where appropriate, according to the US Army Corps of Engineers Standards for Recreation Facilities. Commercial refuse disposal contractors would be engaged to collect and dispose of the contents of receptacles. A pack-it-in, pack-it-out policy would be established at primitive sites and trails.

F.3.42. Site Work: Grading and Landscaping. The approach to all site work would be to minimize impact on the existing conditions.

- Clearing and Grubbing

  Specimen trees would be retained when possible; cleared areas would be contoured and seeded to prevent erosion.

- Grading

  The extent and impact of grading operations would be minimized. Natural appearance and smooth transition to existing grade is desirable.

- Seeding and Sodding

  Large areas disturbed by construction would be seeded and mulched. Areas would be sodded near buildings or major activities, where it is imperative to establish grass quickly.

- Landscaping

  Landscape planting would be simple, functional, and economical to maintain; generally, plantings would reflect the natural vegetative associations of the site environs.

F.3.43. Signs. The use of signs would be minimized. Signs would be informative and unobtrusive, and the use of graphic symbols is preferred. Signs at areas operated and maintained by the US Army Corps of Engineers should conform to standards of Lower Mississippi Valley Division sign manual DIVR 1130-2-130.

F.3.44. Barrier Free Access. Sites walkways and steps/ramps would be planned to allow access for the handicapped, as provided for in the Architectural Act of 1968 (Public Law 90-490). Handrails would be provided at walks and steps where appropriate. Buildings, and where possible recreation facilities, would include facilities usable by the physically handicapped.

F.3.45. Visitor Safety Control. Control points would be provided at all access points to major recreation developments. Visitor circulation to particular areas of a site could also be controlled.

F.3.46. Visitor Assistance and Protection. Common recurrent hazards and unsafe conditions would be identified and procedures implemented to protect the public and take measures that would minimize the likelihood of personal injury.

- Control Stations

  The function of a control station is to regulate use by collecting fees and issuing use permits, as well as to provide security, first aid, information, and directions.

- Road Gates

  To prevent vehicular traffic into potential danger areas, management areas, or sites closed for operational purposes.

- Protective Fencing

  Fencing, of appropriate type and visual character, would be utilized to prevent access to certain areas or sites where dangerous situations exist.

F.3.47. Flood-Proofing. Recreational facilities would be located above the 10-year flood plain where practicable. If subject to flooding, the facilities would be designed to stay in place during flood conditions and to facilitate clean-up and restoration to service afterwards.

F.3.48. Recreational structures that are subject to damage by flooding would be located above the 100-year flood plain where practicable. Elevations may be raised by filling or by structural means. At locations where this is not practicable, the structures and facilities would be constructed of materials that would not be severely damaged by flooding. Structures subject to flooding should be designed to accommodate hosing out of silt and sediment after flooding.

F.3.49. A system for disconnection of electrical service and other utilities that could be damaged or create a hazard would be located above the flood plain.

DETAILED DEVELOPMENT PLAN

F.3.50. The outstanding recreational attraction of the Atchafalaya Basin is implicit in its relatively undeveloped natural environment. While low-lying swamps and periodic inundations have hindered large land-use changes and curtailed development, they have also provided a degree of protection to the basin and have helped to preserve its natural character. This plan recognizes these inherent natural qualities; and while not attempting to disrupt them, does attempt to make the basin more accessible to the public. The concept of use is to provide large areas of undeveloped lands as the base of public use and develop necessary facilities to support that use at strategic locations.

F.3.51. The primary recreation attraction would be based on those lands secured for public access. Most of these lands would remain in a natural state, having little or no development. Hunting would likely be the main land-based activity; while, fishing would be the major water-based activity. Nonconsumptive recreational uses would be specifically provided for in the development of a portion of the publicly accessible land.

F.3.52. The most intensively developed areas would provide three campground parks (Figure F-3-1). Plate F-1 shows the approximate locations of campground sites A, B, and C. Sites A and B were chosen because of their proximate locations to I-10, the major transportation route which crosses the basin floodway, and because of their direct accessibility to the Baton Rouge and Lafayette metropolitan areas. Both sites would serve the northern protion of the basin, with Site A

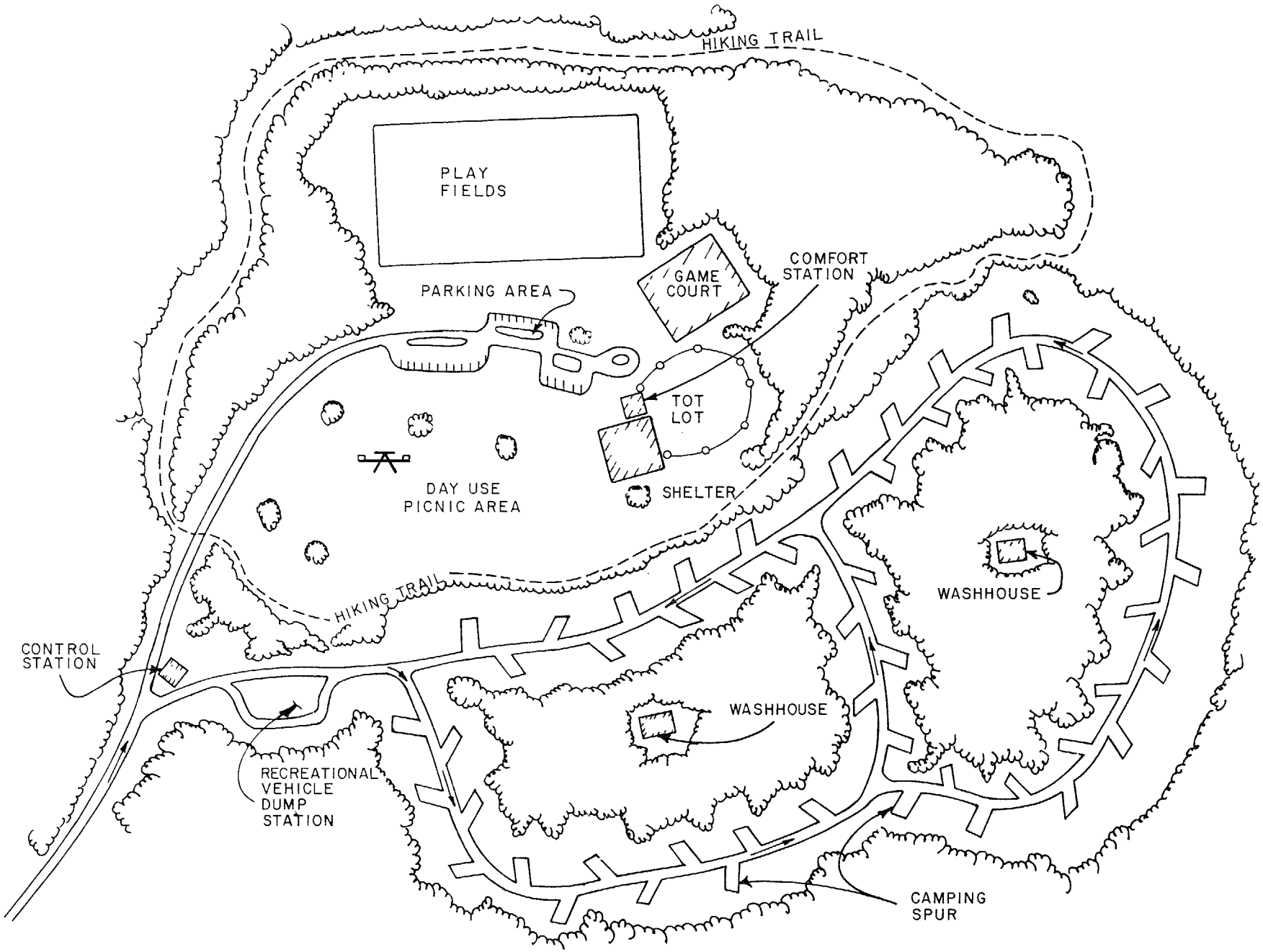


FIGURE F-3-1 CONCEPTUAL SITE DEVELOPMENT PLAN

serving areas west of the Atchafalaya River and Site B serving areas east of the Atchafalaya River. Two sites are proposed, because the only road link between the two park sites is I-10, which bridges the river that forms a natural barrier to cross-basin use. Site C, which lies along State Highway 70 about 16 miles north of Morgan City and US Highway 90, was selected to provide camping to users of the southern half of the basin. No campground development is recommended on the western side of the lower half of the basin floodway because of Lake Fausse Point State Park, which is currently being constructed in that general area. Camping facilities are part of its developmental scheme.

F.3.53. Sites A and C would encompass 200 acres each, while Site B would total 300 acres. Each site would consist of a 100-acre park development and an additional 100 acres for future expansion. In addition, Site B would contain a 100-acre area for the development of a combination nature and hiking trail. All three sites are located on lands of higher elevation that are flooded less frequently.

F.3.54. Each park would be developed for both overnight and day-use and would contain 100 campsites that are fully developed for use by camping trailers and recreational vehicles. Some sites would be constructed and specifically designated for use by the handicapped. Included amenities are concrete tables and impact pads, electrical hook-ups, water, charcoal grills, and trash receptacles at each campsite. Actual park design may include areas for tent camping only; however, for this study effort no such specific allowance has been made.

F.3.55. Each campground would also provide washhouses with hot showers, a recreational vehicle dump station, and a park attendant control station. A tot-lot type playground, game field, and game court for each park would also be provided as support facilities for campers. A separate day-use area consisting of 25 picnic tables with grills, a picnic shelter, a courtesy fishing pier (if feasible) and a comfort station would be provided for day-use visitors at each of the three parks.

F.3.56. It is anticipated that water would be supplied by a drilled well and pressure system, and sewage would be disposed of by septic systems. Park access roads and interior circulation roads would be hard-surfaced.

F.3.57. The park at Site B would also include a 5-mile-long raised boardwalk nature-interpretive trail that wanders over and through an adjacent swampland ecosystem.

F.3.58. Although the three developed parks would act as support facilities for visitors who wish to pursue interests on the many acres of undeveloped public access lands located throughout the basin, these

campgrounds would be completely developed and self-sustaining, offering a wide spectrum of onsite recreational uses.

F.3.59. The initial 100-acre development is appropriate for that scale of use envisioned for the immediate future, based upon today's needs.

F.3.60. The 100 acres set aside for future expansion at each of the developed campgrounds are necessary to provide for long-range future recreational needs, which are difficult to assess by today's standards but which will most likely occur as the use and popularity of the floodway and its natural and recreational attributes become more widely recognized. The detailed development of these acres is incumbent upon future planning efforts.

F.3.61. While the developed campsites serve overnight and day-use in proximity to the highways, seven primitive campsites would be developed to accommodate users within the interior of the floodway where road access is limited or nonexistent. These primitive camping areas would be located along scenic interior corridors and would be accessed by boat and/or canoe.

F.3.62. In most instances these areas are linked by waterways that form a continuous north-south canoe trail that runs the length of the basin floodway. Depending upon the specific location and water elevation, some of the primitive campgrounds may be accessible to hikers. The approximate locations of the seven primitive camping areas are shown on Plate F-1. Where feasible, intervals between the sites were placed at distances that would accommodate a day's travel by canoe. Each of the seven primitive camping areas would be 50 acres in size and have 25 campsites per area. Each campsite would consist of a brush-cleared area and a fire ring. Trash would be carried out by the individual and be deposited at the trail head boat launch area. Each campground would be provided with a vault-type or portable comfort station, where feasible and necessary. Water on each site would be supplied by hand-pump wells where feasible.

F.3.63. A mile-long hiking trail would also be provided at each campground. These trails would be developed along the campground's fee perimeter and would require no additional acquisition for public access. Trailheads would be established for the primitive camping areas. Primitive campers would utilize designated existing and proposed launch areas as a point of embarkation, as well as a point of exit. These designated boat-launching areas would be upgraded or developed to accommodate additional parking for recreationists wishing to use the primitive campgrounds. A primitive campground, while minimal in terms of development, would be a major asset in the overall recreation plan. It would provide the means for overnight use of the interior of the basin while increasing the diversity of use, and yet maintaining a minimal development concept.

F.3.64. The major means of accessing the interior of the Atchafalaya Basin Floodway is by boat. Adequate boat-launching areas are very important in providing for overall public recreational use. A recreational facilities inventory of the basin has identified 44 existing boat-launching sites that are currently being used for interior access. While some are private commercial launch sites, many are public. An inventory of public ramps revealed that many are in poor condition and are not being maintained.

F.3.65. Based on an analysis of existing use conditions and pressures, this plan recommends the upgrading of 10 existing launch ramps. Five of the ramps would be upgraded to five lanes each, and five ramps would be upgraded to two lanes each. Parking at each would be expanded. In addition, five new ramps (two 5-lane ramps and three 2-lane ramps) are proposed for development. Plate F-1 identifies the approximate location of each ramp to be upgraded or constructed.

F.3.66. Each proposed launch area would encompass 10 acres and provide permanent concrete ramps and paved parking: 50 car and trailer spaces for 5-lane ramps, or 25 car and trailer spaces for 2-lane ramps. Each ramp would have one courtesy dock and where feasible, lighting. In addition, a comfort station, five picnic tables, five barbeque grills, and five trash receptacles would be provided at each launch area. In many areas, public access across the levees is prohibited. The launch areas would provide for public access across levees in these instances. As such, their importance extends beyond that of boat-launching areas in providing a means of public access for crawfishing, bankfishing, and other recreational activities. In addition, many of the launch areas would serve as the staging areas for primitive campers. Launch areas would play an important dual role in facilitating public recreational use of the basin.

F.3.67. The US Army Corps of Engineers, would construct and operate a Project Visitor's Center, located on 100 acres near the Bayou Sorrel Indian Mound Site on the east side of the lower Atchafalaya Basin Floodway.

F.3.68. The Project Visitor's Center is required to serve a number of functions to accomplish its purpose of communicating the reason for the Atchafalaya Basin Floodway and related project features. To merely echo past and present project planning, construction, and operation processes would not provide the visitor with adequate information to comprehend the rationale and history of a project dating back some 50 years and continuing into the future. To accomplish these objectives, the Project Visitor's Center would:

- Involve the visitor emotionally and physically with the site, and thus, in the floodway project

- Provide the visitor with the information necessary to explore the full range of recreational opportunities made available by the floodway

- Provide an interpretation of the natural resources intrinsic to the Atchafalaya River Basin and the floodway

- Provide and interpretation of the cultural resources related to the Atchafalaya Basin, focusing on the continuing interaction of man with the floodway

- Interpret the role of the US Army Corps of Engineers in the development of the floodway

- Provide information that would enable the visitor to make a conceptual linkage between the Visitor's Center site and other significant sites associated with the project

- Be a visual symbol of the project's emphasis, quality, and purpose.

F.3.69. Achieving these objectives would instill the visitor with an emotional as well as physical consciousness of the floodway's purpose, creation, and benefits.

F.3.70. There are several reasons for selecting the Bayou Sorrel Indian Mound site as the location for the multi-use project Visitor's Center. The mound itself is a highly significant cultural resource because it has been identified as one of the key sites in the Atchafalaya Basin that has the potential of revealing historical succession, and affords opportunity to study human adaptation to a changing environmental setting. The site is conducive to interpretive presentation and is publicly accessible from I-10 and from the Plaquemine, Baton Rouge, and Morgan City areas. In addition, this site location would not conflict with that of the planned Atchafalaya Wilderness Center, which will be constructed by the Louisiana State Parks Department near Catahoula on the west side of the floodway.

F.3.71. The Visitor's Center would include a museum and audio-visual interpretive elements housed in an attractive rustic contemporary structure. The theme of the exhibits would interpret the role of the US Army Corps of Engineers in the development of the project, as well as natural and cultural resources of the region.

F.3.72. Ancillary facilities would be developed on the Visitor's Center site. A 25-unit picnic area would be constructed close to the center, as well as an amphitheater designed to seat 100 persons. These facilities would support heavier use during the summer. The amphitheater would be built close to the trailhead of a 1.5-mile nature trail and would serve as a gathering point for visitors

awaiting guided nature walks. The amphitheater would be used for outdoor interpretive programs during warm-weather months.

F.3.73. The facility development as described in this section is summarized by type and number in Table F-3-1.

F.3.74. Two existing facilities have been identified as having the potential to be upgraded into visitor information centers capable of disseminating current and useful information about the Atchafalaya Basin Floodway and directing potential visitors to its attractions. The I-10 Rest Stop at the Butte LaRose Interchange and Brownell's Memorial Park and Carillon Tower just northeast of Morgan City are ideally located to provide services to the majority of cross-basin travelers, and as visitor information centers, would greatly aid in optimizing public access and use of the Atchafalaya Basin Floodway and its resources.

TABLE F-3-1

ATCHAFALAYA BASIN STUDY
RECOMMENDED PLAN OF RECREATIONAL DEVELOPMENT
FACILITY DEVELOPMENT SUMMARY

Facility Development	Campgrounds	Primitive Campgrounds	Visitor Center	Boat-Launching Areas	Elevated Nature-Hiking Trail	Totals
Number of Development Sites	3	7	1	15	1	27 sites
Acres	600	350	100	150	100	1,300 acres [1/]
Developed Camping Units	300					300 units
Tent Camping Pads	300					300 pads
Day-Use Picnic Units	75		25	75		175 units
Playgrounds	3					3 playgrounds
Playfields	3					3 playfields
Multi-Use Courts	3					3 multi-use courts
Nature Trail						0
Fishing Pier	3					3 fishing piers
Hiking Trail Miles		7	1.5			8.5 miles hiking trail
Five Lane Boat-Launching Areas				7		35 lanes
Two Lane Boat-Launching Areas				8		16 lanes
Amphitheater			1			1 amphitheater
Picnic Shelter	3					3 picnic shelters
Comfort Station (Waterborne)	3		1			4 comfort stations
Comfort Station (Vault)		7		15		22 comfort stations
Control Station	3					3 control stations
Washhouse	6					6 washhouses
Graded Primitive Camping Site (Including Fire Ring)		175				175 units

[1/] 200 acres designated for special or unique features are not included in 1,300 acre total.

Section 4 - ANNUAL VISITATION CALCULATIONS

F.4.1. Annual recreation attendance has been calculated by the Capacity Method of Determining Use, as presented in Section 713.917b.(4) contained in ER 1105-2-300, 15 July 1980. In using this method, recreational use is held constant over time; therefore, future use projections will not differ from initial use projects resulting from the implementation of the recommended recreation plan.

F.4.2. To determine annual use, the optimum use standards presented in Table F-2-2 were multiplied by the number of facilities recommended for development to determine the daily facility design capacities. The design capacities were then multiplied by 91.5 high quarter days to measure optimal use in that period of the year where it would most likely approach the facility design capacity. By determining high quarter use, annual attendance could be calculated by expanding high quarter use over the remaining three quarters of the year.

F.4.3. From the Outdoor Recreation Resources Review Commission (ORRRC) Study Report No. 19, page 363, the percentage by summer high quarters of recreation outings which occurred was analyzed to yield a conversion factor of 50.7 percent for active recreational pursuits, excluding activities, such as sightseeing, for which no unit standard has been developed. By applying this 50.7 percent conversion factor, the high quarter use can be annualized.

F.4.4. To convert to user days of annual attendance, annual respective activity occasions excluding those for boat fishing and the different hunting activities were divided by 1.28, the national average number of activity occasions per user day for all US Army Corps of Engineers Water Resource Development Projects. For this study, boat fishing and the different hunting activities are equated on a one-to-one basis per use day in the project area. This is based upon observed duration of use as reflected in the 1971-1974 "Atchafalaya Basin Usage Study." Table F-4-1 shows the incremental calculations and the computed total annual use that would occur in the Atchafalaya Basin Floodway upon implementation of the recommended recreation plan.

F.4.5. There are several modifications to the calculations that should be noted:

- Multi-use fields normally have a turnover rate of 2. Because of the remoteness of developed camping and the lesser amount of anticipated day-use, the "turnover rate" is expected to be less than 2, hence 1.

TABLE F-4-1

ANNUAL VISITATION CALCULATIONS

	Number of Facilities	Users Per Facility	Turnover Rate Per Day	Facility Design Capabilities in Activity Occasions	High Quarter Factor 91.5 Days	Activity Annualization Factor 0.507	Activity Occasion Conversion Factor	Total Annual Visitation
General Recreation								
1. Primitive Camping	175 units	4	1	700	64,050	126,331		
2. Developed Camping	300 units	4	1	1,200	109,800	216,568		
3. Hiking	12 miles	5	4	240	21,960	43,314		
4. Nature Trail	1 trail	10	4	40	3,660	7,219		
5. Nature Photography/ Birdwatching	2 miles	10	4	80	7,320	14,438		
6. Picnicking	175 units	3.85	2	1,348	123,296	243,188		
7. Picnic Group Shelter	3 shelters	7.5	2	45	4,118	8,122		
8. Multi-use Field	3 fields	20	1	60	5,490	10,828		
9. Multi-use Court	3 courts	10	1	30	2,745	5,414		
10. Playground	3 playgrounds	31	1	93	8,510	16,785		
11. Amphitheater	1 amphitheater	100	1	100	9,150	18,047		
12. Power Boating	15 lanes	4	16	960	87,840	173,254		
13. Nonpower Boating	3 lanes	2.25	16	108	9,882	19,491		
					Subtotal	902,999	1.28	705,468
Fishing								
14. Fishing, Boat	35 lanes	2.5	20	1,750	160,125	315,828		315,828
15. Fishing, Pier	3 piers	5	2	30	2,745	5,414		
16. Fishing, Bank	9.5 miles	48	3	1,368	125,172	246,888		
17. Crawfishing	6 miles	20	1	120	10,980	10,980		
18. Crabbing	6 miles	66	1	396	36,234	36,234		
					Subtotal	299,516	1.28	233,997
						GRAND TOTAL		1,255,293

• The nature trail at developed campsite B is 5 miles in length, thereby giving it use characteristics that more nearly approach those of a hiking trail--the activity type that it was measured under.

• Power boating and nonpower boating were noted as having 15-lane and 3-lane equivalents of supply, respectively. This is based upon the amount of time in a day that a lane could be utilized by one of these activities. Thirty-five lanes that accommodate boat fishing also accommodate 4 hours or 1/2-day of use per lane per day of power and/or nonpower boating. The method for determining the amount of lane equivalent use by these activities is:

• 35 lanes x 4 hours use for power and nonpower = 140 hours use per day of availability

• 140 hours per day ÷ 8 hours in a day = 17.5 lanes of availability per day

• According to the needs analysis for year 2030:

Power boat needs	=	303 lanes
Nonpower boat needs	=	42 lanes
TOTAL		345 lanes needed

• 303 ÷ 345 = 0.88 or 88 percent of the toal is power boat need

• 42 ÷ 345 = 0.12 or 12 percent of the total is nonpower boat need

• 17.5-lane equivalents supplied x 0.88 = 15-lane equivalents allocated to power boating

o 17.5-lane equivalents supplied x 0.12 = 3-lane equivalents allocated to nonpower boating.

F.4.6. While many areas will be available for bankfishing, crawfishing, and crabbing, projected annual visitation is calculated for designated areas where road access is to be provided. These designated areas are generally found at proposed and/or existing launch sites, and are expected to receive the most concentrated use. Areas excluded from this measurement should not be considered as having no recreational use potential. Some areas, including a large portion of the publicly accessible acres of cypress-tupelo, offer great crawfishing potential; however, access is limited only to boats, thereby reducing the intensity of use which is in itself difficult to measure.

F.4.7. Crabbing and crawfishing were converted from users per linear foot to users per linear mile. Calculated attendance for these activities is computed as follows:

- Crawfishing:

  5,280 feet ÷ 266 feet/user = 20 users/mile
  20 users/mile x 6 miles = 120 users or the daily facility design capacity
  120 users/mile x 91.5 high quarter days = 10,980 users/high quarter.

- Crabbing:

  5,280 feet ÷ 80 feet/user = users/mile
  66 users/mile x 6 miles = 396 users or the daily facility design capacity
  396 users/mile x 91.5 high quarter days = 36,234 users/high quarter.

F.4.8. Crabbing and crawfishing both occur on a strictly seasonal basis. Expansion to an annual figure by use of the 0.507 conversion factor for these activities would be erroneous. Thus, for visitation calculations, respective high quarter uses for these activities are to be considered as respective total annual visitation for each.

F.4.9. Birdwatching and nature photography will be provided at the 200-acre special and unique site. For attendance calculations, that area is expected to receive use that approximates that of a developed nature trail.

Section 5 - PLAN ALTERNATIVE ASSESSMENT

F.5.1. General. Fishing and hunting are the most significant recreational activities that occur in the Atchafalaya Basin. This is substantiated by data contained in past user studies, by present day observations of existing recreational use trends, and by future needs, as exhibited in comprehensive recreation demand-need analyses of the basin's market area and zone of influence. The following analyses address the impacts of each plan alternative under consideration as part of the Atchafalaya Basin Land and Water Use Study on the land and water resources that will support these activities.

RECREATIONAL WATER USE ANALYSIS

F.5.2. In the Atchafalaya Basin recreation demand-need analysis, water-based recreational activities were analyzed from the standpoint of access. As stated in the Louisiana State Comprehensive Outdoor Recreation Plan (SCORP), Louisiana has an abundance of both fresh and saltwater areas with recreation potential. However, many of these areas are unavailable to the public because of a lack of boat access sites. Boat access to suitable water is a major consideration of water-based activities. Therefore, the supply, demand, and needs calculations concerning these activities were based on boat access or boat-launching ramps. To properly evaluate the future carrying capacities of the floodway in terms of the overall development of boat launching facilities (existing and proposed) and the amount of surface water acreage needed to support their launching capabilities under all plan alternatives, the following analysis was performed.

F.5.3. Primary consideration is given to freshwater boat fishing, which is the most frequently pursued water-based recreational activity occurring in the floodway. Power boating and nonpower boating are second and third, respectively, in their frequency of use. Water-skiing in the basin is minimal. Existing development will provide adequately for that activity. The facility use standards as stated in the demand-need analysis section of Appendix F and the water acreage use standard as derived from the Louisiana SCORP are presented for the above boating activity types to calculate acres of need per lane per day.

- Boat fishing

  Acreage needed for one boat/day = 8
  Water turnover/day = 3
  Boat launch lane turnover/day = 20
  20 x 1/3 x 8 = 53.28 acres need/lane/day

- Power Boating

  Acreage needed for one boat/day = 20
  Water turnover/day = 3
  Boat launch lane turnover/day = 16
  20 x 1/3 x 16 = 107 acres need/lane/day.

- Nonpower Boating

  Acreage needed for one boat/day = 24
  Water turnover/day = 3
  Boat launch lane turnover/day = 16
  24 x 1/3 x 16 = 128 acres need/lane/day.

F.5.4. Lane-use allocation is based primarily upon the ranking of importance for the respective water-based recreational activity in terms of both actual use and market area need.

F.5.5. The importance and priority ranking of the three boating activities have been previously stated, and the 2030 market area need for these activities reflects that ranking.

Boat Fishing	474 lanes
Power Boating	303 lanes
Nonpower Boating	42 lanes

F.5.6. Including the 35 lanes proposed for construction, a project total of 132 lanes will access the floodway's interior in the year 2030. Based on the above stated priorities and information contained in the discussion of facility use standards and modifications, the 132 boat launching lanes will accommodate 10 hours or a full day of boat fishing and 4 hours or one-half a day to be divided between power and nonpower boating. Use allocated to power and nonpower boating will be prorated on a percentage of need basis.

	2030 Need	Percent of Total
Power Boating	303 lanes	87
Nonpower Boating	42 lanes	13
TOTAL	345 lanes	100

F.5.7. A full day of boat fishing constitutes use of 132 lanes; a 1/2 day of power and nonpower boating combined constitutes an equivalent use of 66 lanes (132 lanes x 1/2-day = 66 equivalent lanes of availability per day). When divided on the prorated percentage basis, 57 of the 132 lanes will be allocated to power boating and nine of the 132 lanes will be allocated to nonpower boating.

F.5.8. Total water surface acres needed per day to accommodate the optimal use generated by the 132 lanes can be calculated by

multiplying lane allocations for each activity type by the number of acres needed per lane per day and summing the acreage need of each.

Activity	Lane Allocation	Water Surface Acres of Need/Lane/Day	Water Surface Acres of Need/Lane/Day
Boat Fishing	132	53.28	7,033
Power Boating	57	107	6,099
Nonpower Boating	9	128	1,152
Total Need of Water Surface Acres			14,284

F.5.9. The total water surface acreage of need for the Atchafalaya Basin Floodway for the year 2030 based upon boat access for water-based recreational use is 14,284 acres. This acreage of need will remain constant over the rest of the project life in the absence of additional boat-launching facility construction.

F.5.10. In considering the impacts of each plan alternative on water-based recreational activities requiring boat access to the Atchafalaya Basin Floodway, the total number of water surface acres of available supply to support boating activities versus acres needed were comparatively analyzed, with the following conclusions.

F.5.11. Most all water-related recreational activities requiring boat access will occur on three distinct aquatic habitat types: bayous, headwater lakes, and backwater lakes. The total combined supply acreage figures of these habitat types for the year 2030 for the three different plans under consideration range from a minimum of 27,776 water surface acres for Plan 7 (NED) to a maximum of 34,029 water surface acres for Plan 4 (EQ). Data are not available to forecast conditions beyond 2030, but if trends under any plan continue throughout the project life, future water surface acres would continue to decrease but still be able to sustain projected future use.

F.5.12. Both Plan 4 (EQ) and Plan 9 (R) include real estate features that will increase public access and recreational use of the floodway. If implemented, either plan would, as a result of recreational development, produce a gross water surface acreage need of 14,284 acres for the year 2030 for water-based recreational activities requiring boat access to the floodway. As these plan alternatives have the most extensive recreational development features when compared to others under consideration, they reflect maximum gross need figures for all plan alternatives.

F.5.13. Because the maximum gross need figure of 14,284 water surface acres for all plan alternatives is well below the minimum amount of available supply acres for each plan alternative, there are no tangible net impacts between the future without-project and the

different plan alternatives on the basis of water-oriented recreation. Losses will, however, decrease the quality of the outdoor experience as preferred aquatic habitat types, such as headwater and backwater lakes, decrease in total acreage causing a shift in future use concentrations to the less preferred bayous and canals.

RECREATIONAL LAND USE ANALYSIS

F.5.14. Each plan alternative as analyzed in this study effort will have a generally predictable effect on the terrestrial habitat types located within the project area. Shifts in the types and amounts of each habitat will impact the physical and biological resource potentials that attract and support recreational use.

F.5.15. The assessment of impacts on recreation is complicated because the three plan alternatives under consideration have existing recreational usage that will be affected by the above mentioned land changes, while two of the three plans have proposed additional recreational development features that will incur recreational usage over and above that usage common to all plans.

F.5.16. To assess the impacts of the three plan alternatives on recreation, each plans impacts on existing and future recreation usage was evaluated by comparing existing use trends with the availability of different land-use types and projecting these amounts into the future, with the impacts of the proposed features being added on for those plan alternatives that incorporate recreational development.

F.5.17. The exact amount of existing recreation use occurring in the Atchafalaya Basin is not known, although the major activity types, as well as general use patterns, have been identified. Quantification has not been possible because of a lack of data and difficulty in estimating use of private land for recreation; however, it is known that hunting is the primary land-based activity pursued in the basin, and it occurs predominantly on private land. Measuring the effects of land changes on hunting for each alternative will be a prime determinant in assessing the impacts of that plan for several reasons. Hunting has dominated as an activity that has been less susceptible to population changes and user preferences. Hunting relies heavily on the existing land types to support the current use levels, and any change in land types and amounts resulting from a plan implementation will alter that activity level. The capacity of the land to support a given number of man-days per acre of hunting supply based upon habitat carrying capacity (biological sustained harvest rate) can be measured according to gains or losses of habitat acreage, and thereby serves as a means to effectively evaluate the impacts of the different plan alternatives on recreation.

F.5.18. The recommended recreational development features impose identical impacts on those plan alternatives in which they are incorporated. The recreation plan provides for public facility development, as well as for stewardship of prime, publicly accessible, yet undeveloped lands.

F.5.19. The actual development of lands will occur on 1,500 acres, and while eliminating the existing hunting use, will provide more diverse and intense recreational uses. Hunting lands will be replaced by camping areas, picnic areas, and boat-launching areas. The net contribution in user-days of recreation supply of the developed recreation plan will be the number of days that the plan provides less the number of days of existing use displaced by the development.

F.5.20. The undeveloped land to which access is acquired will, under a management and enhancement program, yield a higher and better use in terms of a net increase and supply of man-days of recreational hunting. These additional days of supply will be added to those of the respective plan alternatives and comparatively analyzed.

F.5.21. The results of comparative analysis of each plan alternative are shown in Tables F-5-1 through F-5-6. The tables show total acres available for each hunting activity by habitat type (described in detail in the EIS), carrying capacity (biological harvest rate in man-days per acre for each hunting activity type), man-days of hunting supply, and total gains or losses in 10-year increments from 1986-2036 for the various plan alternative as compared with those of the future without-project conditions. Acreage figures are adjusted to account for shifts in land-use from private to public and from nondeveloped to developed, as based upon the implementation of respective plan alternatives. The year 1986 was used for these calculations because it was established as the first year of economic life for the project. Values calculated for the year 2030 will be held constant throughout the additional 50 years of the project life for economic valuation purposes. Although no detailed data is available for those 50 years of the project life beyond 2030, general impacts based on trend analyses are addressed for that time period. The comparative impact calculations of the recommended plan are not shown in tabular form; however, the results are included in Table F-5-7 and discussed in the narrative in section F.5.32.

DOLLAR VALUATION OF RECREATION USER DAYS

F.5.22. The Water Resources Council in its "Procedures for Evaluation of National Economic Development (NED) Benefits and Costs In Water Resources Planning" (Level C); Final Rule, describes several different methodologies for evaluating recreation benefits. The preferred means to forecast use and derive recreation benefits are through the

TABLE F-5-1

ATCHAFALAYA BASIN STUDY
FLOODWAY AND 1/4-MILE STRIP
IMPACTS OF PLAN ALTERNATIVES

	Big Game		Plan 2 (FWOP)				Plan 4 (EQ)				Plan 7 (NED)				Plan 9 (TS)			
Habitat Type	Hunting Carrying Capacity	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Year
LSBH	0.209	253,000		253,000	52,877	260,000	-14,000	216,000	45,144	253,000		253,000	52,877	260,000	-14,000	216,000	45,144	1986
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	260,000		30,000	16,170	
ESBH	0.124	73,800		73,800	9,151	76,300	-1,900	74,400	9,226	73,800		73,800	9,151	76,300	-1,900	74,400	9,226	
CU	0.124	6,400		6,400	794	5,500		5,500	682	6,400		6,400	794	5,500		5,500	682	
BH/CT	0.101	10,400		10,400	1,050	11,700		11,700	1,182	10,400		10,400	1,050	11,700		11,700	1,182	
C-T	0.077	173,000		173,000	13,321	171,000	-8,000	113,000	8,701	173,000		173,000	13,321	171,000	-8,000	113,000	8,701	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,560	
OL	0	23,500		23,500	0	16,000	-100	15,900	0	23,500		23,500	0	16,000	-100	15,900	0	
FH	0.014	0		0	0	0		0	0			0	0	0		0	0	
SH	0	0		0	0	0		0	0			0	0	0		0	0	
BH	0	0		0	0	0		0	0			0	0	0		0	0	
D	0.014	0		0	0	0		0	0			0	0	0		0	0	
Total					77,193				86,755				77,193				86,755	
LSBH	0.209	225,000		225,000	47,025	266,000	-14,000	222,000	46,398	224,000		224,000	46,816	266,000	-14,000	222,000	46,398	1996
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	58,200		58,200	7,217	64,100	-1,900	62,200	7,713	63,800		63,800	7,911	64,500	-1,900	62,600	7,762	
CU	0.124	16,800		16,800	2,083	14,400		14,400	1,786	14,600		14,600	1,810	14,400		14,400	1,786	
BH/CT	0.101	12,400		12,400	1,252	17,100		17,100	1,727	22,900		22,900	2,313	17,100		17,100	1,727	
C-T	0.077	166,000		166,000	12,782	162,000	-8,000	104,000	8,008	154,000		154,000	11,858	162,000	-8,000	104,000	8,008	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	61,500		61,500	0	16,800	-100	16,700	0	63,900		63,900	0	17,000	-100	16,900	0	
FH	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SH	0	0		0	0	0		0	0	0		0	0	0		0	0	
BH	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					70,359				87,452				70,708				87,501	
LSBH	0.209	169,000		169,000	35,321	265,000	-14,000	221,000	46,189	166,000		166,000	34,694	265,000	-14,000	221,000	46,189	2006
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	50,000		50,000	6,200	61,100	-1,900	59,200	7,341	54,900		54,900	6,808	61,500	-1,900	59,600	7,390	
CU	0.124	27,100		27,100	3,360	23,100		23,100	2,864	23,400		23,400	2,902	23,100		23,100	2,864	
BH/CT	0.101	11,400		11,400	1,151	22,600		22,600	2,283	27,600		27,600	2,788	22,600		22,600	2,283	
C-T	0.077	159,000		159,000	12,243	153,000	-8,000	95,000	7,315	140,000		140,000	10,780	153,000	-8,000	95,000	7,315	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	127,000		127,000	0	17,800	-100	17,700	0	133,000		133,000	0	18,100	-100	18,100	0	
FH	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SH	0	0		0	0	0		0	0	0		0	0	0		0	0	
BH	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					58,275				87,812				57,972				87,861	
LSBH	0.209	131,000		131,000	27,379	264,000	-14,000	220,000	45,980	125,000		125,000	26,125	264,000	-14,000	220,000	45,980	2016
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	41,700		41,700	5,171	58,700	-1,900	56,800	7,043	46,300		46,300	5,741	59,000	-1,900	57,100	7,080	
CU	0.124	37,300		37,300	4,625	31,900		31,900	3,956	32,200		32,200	3,993	31,900		31,900	3,956	
BH/CT	0.101	10,400		10,400	1,050	28,100		28,100	2,838	31,900		31,900	3,222	28,100		28,100	2,838	
C-T	0.077	153,000		153,000	11,781	146,000	-8,000	88,000	6,776	127,000		127,000	9,779	146,000	-8,000	88,000	6,776	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	174,000		174,000	0	18,400	-100	18,300	0	185,000		185,000	0	18,700	-100	18,600	0	
FH	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SH	0	0		0	0	0		0	0	0		0	0	0		0	0	
BH	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					50,006				88,413				48,860				88,450	
LSBH	0.209	114,000		114,000	23,826	263,000	-14,000	219,000	45,771	107,000		107,000	22,363	264,000	-14,000	220,000	45,980	2026
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	35,000		35,000	4,340	56,200	-1,900	54,300	6,733	39,700		39,700	4,923	56,600	-1,900	54,700	6,783	
CU	0.124	47,500		47,500	5,890	40,600		40,600	5,034	41,000		41,000	5,084	40,600		40,600	5,034	
BH/CT	0.101	11,100		11,100	1,121	33,500		33,500	3,384	38,200		38,200	3,858	33,500		33,500	3,384	
C-T	0.077	146,000		146,000	11,242	138,000	-8,000	80,000	6,160	114,000		114,000	8,778	138,000	-8,00	80,000	6,160	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	197,000		197,000	0	19,000	-100	18,900	0	212,000		212,000	0	19,200	-100	19,100	0	
FH	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SH	0	0		0	0	0		0	0	0		0	0	0		0	0	
BH	0	0		0	0	0		0	0	0		0	0	0	0		0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					46,419				88,902				45,006				89,161	
LSBH	0.209	110,000		110,000	22,990	263,000	-14,000	219,000	45,771	102,000		102,000	21,218	264,000	-14,000	220,000	45,980	2036
LSBH	0.539	-		-	0	-		30,000	16,170	-		-	0	-		30,000	16,170	
ESBH	0.124	32,600		32,600	4,042	55,200	-1,900	53,300	6,609	37,300		37,300	4,625	55,600	-1,900	53,700	6,659	
CU	0.124	51,600		51,600	6,398	44,100		44,100	5,468	44,600		44,600	5,530	44,100		44,100	5,468	
BH/CT	0.101	11,700		11,700	1,182	35,700		35,700	3,606	41,000		41,000	4,141	35,700		35,700	3,606	
C-T	0.077	144,000		144,000	11,088	135,000	-8,000	77,000	5,929	109,000		109,000	8,393	135,000	-8,000	77,000	5,929	
C-T	0.113	-		-	0	-		50,000	5,650	-		-	0	-		50,000	5,650	
OL	0	203,000		203,000	0	19,200	-100	19,100	0	220,000		220,000	0	19,400	-100	19,300	0	
FH	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
SH	0	0		0	0	0		0	0	0		0	0	0		0	0	
BH	0	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.014	0		0	0	0		0	0	0		0	0	0		0	0	
Total					45,700				89,203				44,008				89,462	

TABLE F-5-2

ATCHAFALAYA BASIN STUDY
FLOODWAY AND 1/4-MILE STRIP
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Small Game Hunting Carrying Capacity	Plan 2 (FWOP) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Plan 4 (EQ) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Plan 7 (NED) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Plan 9 (TS) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Year
LSBH	0.168	253,000		253,000	42,504	260,000	-1,000	229,000	38,472	253,000		253,000	42,504	260,000	-1,000	229,000	38,472	1984
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	73,800		73,800	3,985	76,300	0	76,300	4,120	73,800		73,800	3,985	76,300	0	76,300	4,120	
CU	0.054	6,400		6,400	346	5,500		5,500	297	6,400		6,400	346	5,500		5,500	297	
BH/CT	0.063	10,400		10,400	655	11,700		11,700	737	10,400		10,400	655	11,700		11,700	737	
C-T	0.072	173,000		173,000	12,456	171,000	-300	121,000	8,712	173,000		173,000	12,456	171,000	-300	121,000	8,712	
C-T	0.072	-		-	-	-		50,000	3,600	-		-	-	-		50,000	3,600	
OL	0.042	23,500		23,500	987	16,000	-100	15,900	668	23,500		23,500	987	16,000	-100	15,900	668	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					60,933				63,776				60,933				63,776	
LSBH	0.168	225,000		225,000	37,800	266,000	-1000	235,000	39,480	224,000		224,000	37,632	266,000	-1,000	235,000	39,480	1996
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	58,200		58,200	3,143	64,100	0	64,100	3,461	63,000		63,000	3,402	64,500	0	64,500	3,483	
CU	0.054	16,800		16,800	907	14,400		14,400	778	14,600		14,600	788	14,400		14,400	778	
BH/CT	0.063	12,400		12,400	781	17,100		17,100	1,077	22,900		22,900	1,443	17,100		17,100	1,077	
C-T	0.072	166,000		166,000	11,952	162,000	-300	112,000	8,064	154,000		154,000	11,088	162,000	-300	112,000	8,064	
C-T	0.072	-		-	-	-		-	-	-		-	-	-		-	-	
OL	0.042	61,600		61,600	2,587	16,800	-100	16,700	701	63,900		63,900	2,684	17,000	-100	16,900	710	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					56,370				64,331				57,037				64,362	
LSBH	0.168	169,000		169,000	28,392	265,000	-1,000	234,000	39,312	166,000		166,000	27,888	265,000	-1,000	234,000	39,312	2006
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	50,000		50,000	2,700	61,100	0	61,000	3,299	54,900		54,900	2,965	61,500	0	61,500	3,321	
CU	0.054	27,100		27,100	1,463	23,100		23,100	1,247	23,400		23,400	1,264	23,100		23,100	1,247	
BH/CT	0.063	11,400		11,400	718	22,600		22,600	1,424	27,600		27,600	1,739	22,600		22,600	1,424	
C-T	0.072	159,000		159,000	11,448	153,000	-300	103,000	7,416	140,000		140,000	10,080	153,000	-300	103,000	7,416	
C-T	0.072	-		-	-	-		500,000	3,600	-		-	-	-		50,000	3,600	
OL	0.042	127,000		127,000	5,334	17,800	-100	17,700	743	133,000		133,000	5,586	18,100	-100	18,000	756	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					50,055				64,211				49,522				64,246	
LSBH	0.168	131,000		131,000	22,008	264,000	-1,000	233,000	39,144	125,000		125,000	21,000	264,000	-1,000	233,000	39,144	2016
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	41,700		41,700	2,252	58,700	0	58,700	3,170	46,300		46,300	2,500	59,000	0	59,000	3,186	
CU	0.054	37,300		37,300	2,014	31,900		31,900	1,723	32,200		32,200	1,739	31,900		31,900	1,723	
BH/CT	0.063	10,400		10,400	655	28,100		28,100	1,770	31,900		31,900	2,010	28,100		28,100	1,770	
C-T	0.072	153,000		153,000	11,016	146,000	-300	96,000	6,912	127,000		127,000	9,144	146,000	-300	96,000	6,912	
C-T	0.072	-		-	-	-		-	-	-		-	-	-		50,000	3,600	
OL	0.042	174,000		174,000	7,308	18,400	-100	-18,300	769	185,000		185,000	7,770	18,700	-100	18,600	781	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					45,253				64,258				44,163				64,286	
LSBH	0.168	114,000		114,000	19,152	263,000	-1,000	232,000	38,976	107,000		107,000	17,976	264,000	-1,000	233,000	39,144	2026
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,176	
ESBH	0.054	35,000		35,000	1,890	56,200	0	56,200	3,035	39,700		39,700	2,144	56,600	0	56,600	3,056	
CU	0.054	47,500		47,500	2,565	40,600		40,600	2,192	41,000		41,000	2,214	40,600		40,600	2,192	
BH/CT	0.063	11,100		11,100	699	33,500		33,500	2,111	38,200		38,200	2,407	33,500		33,500	2,111	
C-T	0.072	146,000		146,000	10,512	138,000	-300	88,000	6336	114,000		114,000	8,208	138,000	-300	88,000	6,336	
C-T	0.072	-		-	-	-		50,000	3,600	-		-	-	-		50,000	3,600	
OL	0.042	197,000		197,000	8,274	19,000	-100	18,900	794	212,000		212,000	8,904	19,200	-100	19,100	802	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		00	0	0		0	0	
Total					43,092				64,714				41,853				64,411	
LSBH	0.168	110,000		110,000	18,480	263,000	-1,000	232,000	38,976	102,000		102,000	17,136	264,000	-1,000	233,000	39,144	2036
LSBH	0.239	-		-	-	-		30,000	7,170	-		-	-	-		30,000	7,170	
ESBH	0.054	32,600		32,600	1,760	55,200	0	552,000	2,981	37,300		37,300	2,014	55,600	0	55,600	3,002	
CU	0.054	51,600		51,600	2,786	44,100		441,000	2,381	44,600		44,600	2,408	44,100		44,100	2,381	
BH/CT	0.063	11,700		11,700	737	35,700		357,000	2,249	41,000		41,000	2,583	35,700		35,700	2,249	
C-T	0.072	144,000		144,00	10,368	135,000	-30	85,000	6,120	109,000		109,000	7,848	135,000	-300	85,000	6,120	
C-T	0.072	-		-	-	-		-	-	-		-	-	-		50,000	3,600	
OL	0.042	203,000		203,000	8,526	19,200	-100	19,100	802	220,000		220,000	9,240	19,400	-100	19,300	811	
FM	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0.024	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.073	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.109	0		0	0	0		0	0	0		0	0	0		0	0	
Total					42,657				64,279				33,381				64,477	

TABLE P-5-3

ATCHAFALAYA BASIN STUDY
FLOODWAY AND 1/4-MILE STRIP
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Waterfowl Hunting Carrying Capacity	Plan 2 (PWOP) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Plan 4 (EQ) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Plan 7 (NED) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Plan 9 (TS) Gross Acres	Adjusted Acres	Net Acres	User Day Supply	Year
LSBH	0.003	253,000		253,000	759	260,000	-1,000	229,000	687	253,000		253,000	759	260,000	-1,000	229,000	687	1986
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	73,800		73,800	221	76,300	0	76,300	229	73,800		73,800	221	76,300	0	76,300	229	
CU	0.003	6,400		6,400	19	5,500		5,500	17	6,400		6,400	19	5,500		5,500	17	
BH/CT	0.004	10,400		10,400	42	11,700		11,700	47	10,400		10,400	42	11,700		11,700	47	
C-T	0.005	173,000		173,000	865	171,000	-300	121,000	605	173,000		173,000	865	171,000	-300	121,000	605	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	23,500		23,500	0	16,000	-100	15,900	0	23,500		23,500	0	16,000	-100	15,900	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0	0	0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1,906				2,035				1,906				2,035	
LSBH	0.003	225,000		225,000	675	266,000	-1,000	235,000	705	224,000		224,000	672	266,000	-1,000	235,000	705	1996
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	58,200		58,200	175	64,000	0	64,100	192	63,000		63,000	189	64,500	0	64,500	194	
CU	0.003	16,800		16,800	50	14,400		14,400	43	14,600		14,600	44	14,400		14,400	43	
BH/CT	0.004	12,400		12,400	50	17,100		17,100	68	22,900		22,900	92	17,100		17,100	68	
C-T	0.005	166,000		166,000	830	162,000	-300	112,000	560	154,000		154,000	770	162,000	-300	112,000	560	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	61,600		61,600	0	16,800	-100	16,700	0	63,900		63,900	0	17,000	-100	169,000	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1780				2018				1767				2020	
LSBH	0.003	169,000		169,000	507	265,000	-1000	234,000	702	166,000		166,000	498	265,000	-1000	234,000	702	2006
LSBH	0.005							30,000	150							30,000	150	
ESBH	0.003	50,000		50,000	150	61,100	0	61,100	183	54,900		54,900	165	61,500	0	61,500	185	
CU	0.003	27,100		27,100	81	23,100		23,100	69	23,400		23,400	70	23,400		23,400	70	
BH/CT	0.004	11,400		11,400	46	22,600		22,600	90	27,600		27,600	110	22,600		22,600	90	
C-T	0.005	159,000		159,000	795	153,000	-300	103,000	515	140,000		140,000	700	153,000	-300	103,000	515	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	127,000		127,000	0	17,800	-100	17,700	0	133,000		133,000	0	18,100	-100	18,000	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1579				2009				1543				2012	
LSBH	0.003	131,000		131,000	393	264,000	-1000	233,000	699	125,000		125,000	375	264,000	-1000	233,000	699	2016
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	41,700		41,700	125	58,700	0	58,700	176	46,300		46,300	139	59,000	0	59,000	177	
CU	0.003	37,300		37,300	112	31,900		31,900	96	32,200		32,200	97	31,900		31,900	96	
BH/CT	0.004	10,400		10,400	42	28,100		28,100	112	31,900		31,900	128	28,100		28,100	112	
C-T	0.005	153,000		153,000	765	146,000	-300	96,000	480	127,000		127,000	635	146,000	-300	96,000	480	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	174,000		174,000	0	18,400	-100	18,300	0	185,000		185,000	0	18,700	-100	18,600	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1437				2013				1374				2014	
LSBH	0.003	114,000		114,000	342	263,000	-1000	232,000	696	107,000		107,000	321	264,000	-1000	233,000	699	2026
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	35,000		35,000	105	56,200	0	56,200	169	39,700		39,700	119	56,600	0	56,600	170	
CU	0.003	47,500		47,500	143	40,600		40,600	122	41,000		41,000	123	40,600		40,600	122	
BH/CT	0.004	11,100		11,100	44	33,500		33,500	134	38,200		38,200	153	33,500		33,500	134	
C-T	0.005	146,000		146,000	730	138,000	-300	88,000	440	114,000		114,000	570	138,000	-300	88,000	440	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	197,000		197,000	0	19,000	-100	18,900	0	212,000		212,000	0	19,200	-100	19,100	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1364				2011				1286				2015	
LSBH	0.003	110,000		110,000	330	263,000	-1000	232,000	696	102,000		102,000	306	264,000	-1000	233,000	699	2036
LSBH	0.005	-		-	-	-		30,000	150	-		-	-	-		30,000	150	
ESBH	0.003	32,600		32,600	98	55,200	0	55,200	166	37,300		37,300	112	55,600	0	55,600	167	
CU	0.003	51,600		51,600	155	44,100		44,100	132	44,600		44,600	134	44,100		44,100	132	
BH/CT	0.004	11,700		11,700	47	35,700		35,700	143	41,000		41,000	164	35,700		35,700	143	
C-T	0.005	144,000		144,000	720	135,000	-300	85,000	425	109,000		109,000	545	135,000	-300	85,000	425	
C-T	0.006	-		-	-	-		50,000	300	-		-	-	-		50,000	300	
OL	0	203,000		203,000	0	19,200	-100	19,100	0	220,000		220,000	0	19,400	-100	19,300	0	
FM	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
SM	0	0		0	0	0		0	0	0		0	0	0		0	0	
BM	0.001	0		0	0	0		0	0	0		0	0	0		0	0	
D	0.002	0		0	0	0		0	0	0		0	0	0		0	0	
Total					1350				2012				1261				2016	

TABLE F-5-4

ATCHAFALAYA BASIN STUDY
MARSH AND BACKWATER
IMPACTS OF PLAN ALTERNATIVES

	Big Game	Plan 2 (FWOP)		Plan 4 (EQ)		Plan 7 (NED)		Plan 9 (TS)		
Habitat Type	Hunting Carrying Capacity	Acres	User Day Supply	Acres	User Day Supply	Acres	User Day Supply	Acres	User Day Supply	Year
LSBH	0.209	84,100	17,577	84,100	17,577	84,100	17,577	84,100	17,577	1986
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,800	347	2,800	347	2,800	347	2,800	347	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	1,000	101	1,000	101	1,000	101	1,000	101	
C-T	0.077	274,000	21,098	274,000	21,098	274,000	21,098	274,000	21,098	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	80,900	0	80,900	0	80,900	0	80,900	0	
FM	0.014	311,000	4,354	311,000	4,354	311,000	4,354	311,000	4,354	
SM	0	102,000	0	102,000	0	102,000	0	102,000	0	
BM	0	86,000	0	86,000	0	86,000	0	86,000	0	
D	0.014	25,000	350	25,000	350	25,000	350	25,000	350	
Total			43,827		43,827		43,827		43,827	
LSBH	0.209	82,200	17,180	81,800	17,096	77,200	16,135	81,800	17,096	1996
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,700	335	3,400	422	4,900	608	4,900	608	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	2,700	273	2,700	273	10,400	1,050	2,700	273	
C-T	0.077	273,000	21,021	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	96,000	0	80,900	0	
FM	0.014	294,000	4,116	294,000	4,116	292,000	4,088	294,000	4,116	
SM	0	93,400	0	93,400	0	93,400	0	93,400	0	
BM	0	81,200	0	81,200	0	81,200	0	81,200	0	
D	0.014	49,900	699	49,900	699	41,900	587	49,900	699	
Total			43,600		43,627		42,103		43,813	
LSBH	0.209	80,400	16,804	80,800	16,887	76,100	15,905	80,000	16,720	2006
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	322	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	4,400	444	4,400	444	5,300	535	4,400	444	
C-T	0.077	272,000	20,944	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	103,000	0	80,900	0	
FM	0.014	279,000	3,906	279,000	3,906	275,000	3,850	278,000	3,892	
SM	0	85,600	0	85,600	0	85,600	0	85,600	0	
BM	0	76,400	0	76,400	0	76,300	0	76,400	0	
D	0.014	74,900	1,049	74,900	1,049	74,400	1,042	74,900	1,049	
Total			43,469		43,716		41,562		43,721	
LSBH	0.209	78,700	16,448	78,300	16,365	75,600	15,800	78,300	16,365	2016
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	322	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	6,100	616	6,100	616	3,900	394	6,100	616	
C-T	0.077	272,000	20,944	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	105,000	0	80,900	0	
FM	0.014	264,000	3,696	264,000	3,696	259,000	3,626	263,000	3,682	
SM	0	78,500	0	78,500	0	78,500	0	78,500	0	
BM	0	71,300	0	71,300	0	71,000	0	71,300	0	
D	0.014	100,000	1,400	100,000	1,400	98,400	1,378	100,000	1,400	
Total			43,426		43,507		41,428		43,679	
LSBH	0.209	77,000	16,093	76,600	16,009	75,600	15,800	76,600	16,009	2026
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	332	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	7,800	788	7,800	788	3,700	374	7,800	788	
C-T	0.077	271,000	20,867	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.014	249,000	3,486	249,000	3,486	244,000	3,416	248,000	3,472	
SM	0	70,700	0	70,700	0	71,800	0	70,700	0	
BM	0	66,300	0	66,300	0	65,400	0	66,300	0	
D	0.014	125,000	1,750	125,000	1,750	122,000	1,708	125,000	1,750	
Total			43,316		43,463		41,528		43,635	
LSBH	0.209	76,300	15,947	75,900	15,863	75,600	15,800	75,900	15,863	2036
LSBH	0.539	-	-	-	-	-	-	-	-	
ESBH	0.124	2,600	322	3,300	409	4,800	595	4,800	595	
CU	0.124	0	0	0	0	0	0	0	0	
BH/CT	0.101	8,500	859	8,500	859	3,600	364	8,500	859	
C-T	0.077	271,000	20,867	273,000	21,021	255,000	19,635	273,000	21,021	
C-T	0.113	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.014	243,000	3,402	243,000	3,402	238,000	3,332	242,000	3,388	
SM	0	67,300	0	67,300	0	69,200	0	67,300	0	
BM	0	64,400	0	64,400	0	63,200	0	64,400	0	
D	0.014	135,000	1,890	135,000	1,890	131,000	1,834	135,000	1,890	
Total			43,287		43,444		41,560		43,616	

TABLE F-5-5

ATCHAFALAYA BASIN STUDY
MARSH AND BACKWATER
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Small Game Hunting Carrying Capacity	Plan 2 (FWOP) Acres	Plan 2 (FWOP) User Day Supply	Plan 4 (EQ) Acres	Plan 4 (EQ) User Day Supply	Plan 7 (NED) Acres	Plan 7 (NED) User Day Supply	Plan 9 (TS) Acres	Plan 9 (TS) User Day Supply	Year
LSBH	0.168	84,100	14,129	84,100	14,129	84,100	14,129	84,100	14,129	1986
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,800	151	2,800	151	2,800	151	2,800	151	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	1,000	63	1,000	63	1,000	63	1,000	63	
C-T	0.072	274,000	19,728	274,000	19,728	274,000	19,728	274,000	19,728	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	80,900	3,398	80,900	3,398	80,900	3,398	80,900	3,398	
FM	0.109	311,000	33,899	311,000	33,899	311,000	33,899	311,000	33,899	
SM	0.024	102,000	2,448	102,000	2,448	102,000	2,448	102,000	2,448	
BM	0.073	86,000	6,278	86,000	6,278	86,000	6,278	86,000	6,278	
D	0.109	25,000	2,725	25,000	2,725	25,000	2,725	25,000	2,725	
Total			82,819		82,819		82,819		82,819	
LSBH	0.168	82,200	13,810	81,800	13,742	77,200	12,970	81,800	13,742	1996
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,700	146	3,400	184	4,900	265	4,900	265	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	2,700	170	2,700	170	10,400	655	2,700	170	
C-T	0.072	273,000	19,656	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	96,000	4,032	80,900	3,398	
FM	0.109	294,000	32,046	294,000	32,046	292,000	31,828	294,000	32,046	
SM	0.024	93,400	2,242	93,400	2,242	93,400	2,242	93,400	2,242	
BM	0.073	81,200	5,928	81,200	5,928	81,200	5,928	81,200	5,928	
D	0.109	49,900	5,439	49,900	5,439	41,900	4,567	49,900	5,439	
Total			82,839		82,805		80,847		82,886	
LSBH	0.168	80,400	13,507	80,800	13,574	76,100	12,785	80,000	13,440	2006
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	4,400	277	4,400	277	5,300	334	4,400	277	
C-T	0.072	272,000	19,584	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	103,000	4,326	80,900	3,398	
FM	0.109	279,000	30,411	279,000	30,411	275,000	29,975	278,000	30,302	
SM	0.024	85,600	2,054	85,600	2,054	85,600	2,054	85,600	2,054	
BM	0.073	76,400	5,577	76,400	5,577	76,300	5,570	76,400	5,577	
D	0.109	74,900	8,164	74,900	8,164	74,400	8,110	74,900	8,164	
Total			83,116		83,289		81,773		83,127	
LSBH	0.168	78,700	13,222	78,300	13,154	75,600	12,701	78,300	13,154	2016
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	6,100	384	6,100	384	3,900	246	6,100	384	
C-T	0.072	272,000	19,584	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	105,000	4,410	80,900	3,398	
FM	0.109	264,000	28,776	264,000	28,776	259,000	28,231	263,000	28,667	
SM	0.024	78,500	1,884	78,500	1,884	78,500	1,884	78,500	1,884	
BM	0.073	71,300	5,205	71,300	5,205	71,000	5,183	71,300	5,205	
D	0.109	100,000	10,900	100,000	10,900	98,400	10,726	100,000	10,900	
Total			83,497		83,535		82,000		83,507	
LSBH	0.168	77,000	12,936	76,600	12,869	75,600	12,701	76,600	12,869	2026
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	7,800	491	7,800	491	3,700	233	7,800	491	
C-T	0.072	271,000	19,512	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	106,000	4,452	80,900	3,398	
FM	0.109	249,000	27,141	249,000	27,141	244,000	26,596	248,000	27,032	
SM	0.024	70,700	1,697	70,700	1,697	71,800	1,723	70,700	1,697	
BM	0.073	66,300	4,840	66,300	4,840	65,400	4,774	66,300	4,840	
D	0.109	125,000	13,625	125,000	13,625	122,000	13,298	125,000	13,625	
Total			83,784		83,895		82,396		83,867	
LSBH	0.168	76,300	12,818	75,900	12,751	75,600	12,701	75,900	12,751	2036
LSBH	0.239	-	-	-	-	-	-	-	-	
ESBH	0.054	2,600	140	3,300	178	4,800	259	4,800	259	
CU	0.054	0	0	0	0	0	0	0	0	
BH/CT	0.063	8,500	536	8,500	536	3,600	227	8,500	536	
C-T	0.072	271,000	19,512	273,000	19,656	255,000	18,360	273,000	19,656	
C-T	0.072	-	-	-	-	-	-	-	-	
OL	0.042	81,000	3,402	80,800	3,398	106,000	4,452	80,900	3,398	
FM	0.109	243,000	26,487	243,000	26,487	238,000	25,942	242,000	26,378	
SM	0.024	67,300	1,615	67,300	1,615	69,200	1,661	67,300	1,615	
BM	0.073	64,400	4,701	64,400	4,701	63,200	4,614	64,400	4,701	
D	0.109	135,000	14,715	135,000	14,715	131,000	14,279	135,000	14,715	
Total			83,926		84,037		82,495		84,009	

TABLE F-5-6

ATCHAFALAYA BASIN STUDY
MARSH AND BACKWATER
IMPACTS OF PLAN ALTERNATIVES

Habitat Type	Waterfowl Hunting Carrying Capacity	Plan 2 (FWOP) Acres	Plan 2 (FWOP) User Day Supply	Plan 4 (EQ) Acres	Plan 4 (EQ) User Day Supply	Plan 7 (NED) Acres	Plan 7 (NED) User Day Supply	Plan 9 (TS) Acres	Plan 9 (TS) User Day Supply	Year
LSBH	0.003	84,100	252	84,100	252	84,100	252	84,100	252	1986
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,800	8	2,800	8	2,800	8	2,800	8	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	1,000	4	1,000	4	1,000	4	1,000	4	
C-T	0.005	274,000	1,370	274,000	1,370	274,000	1,370	274,000	1,370	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	80,900	0	80,900	0	80,900	0	80,900	0	
FM	0.001	311,000	622	311,000	622	311,000	622	311,000	622	
SM	0	102,000	0	102,000	0	102,000	0	102,000	0	
BM	0.001	86,000	86	86,000	86	86,000	86	86,000	86	
D	0.002	25,000	50	25,000	50	25,000	50	25,000	50	
Total			2,392		2,392		2,392		2,392	
LSBH	0.003	82,200	247	81,800	245	77,200	232	81,800	245	1996
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,700	8	3,400	10	4,900	15	4,900	15	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	2,700	11	2,700	11	10,400	42	2,700	11	
C-T	0.005	273,000	1,365	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	96,000	0	80,900	0	
FM	0.002	294,000	588	294,000	588	292,000	584	294,000	588	
SM	0	93,400	0	93,400	0	93,400	0	93,400	0	
BM	0.001	81,200	81	81,200	81	81,200	81	81,200	81	
D	0.002	49,900	100	49,900	100	41,900	84	49,900	100	
Total			2,400		2,400		2,313		2,405	
LSBH	0.003	80,400	241	80,800	242	76,100	228	80,000	240	2006
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	4,400	18	4,400	18	5,300	21	4,400	18	
C-T	0.005	272,000	1,360	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	103,000	0	80,900	0	
FM	0.002	279,000	558	279,000	558	275,000	550	278,000	556	
SM	0	85,600	0	85,600	0	85,600	0	85,600	0	
BM	0.001	76,400	76	76,400	76	76,300	76	76,400	76	
D	0.002	74,900	150	74,900	150	74,400	149	74,900	150	
Total			2,411		2,419		2,313		2,419	
LSBH	0.003	78,700	236	78,300	235	75,600	227	78,300	235	2016
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	6,100	24	6,100	24	3,900	16	6,100	24	
C-T	0.005	272,000	1,360	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	105,000	0	80,900	0	
FM	0.002	264,000	528	264,000	528	259,000	518	263,000	526	
SM	0	78,500	0	78,500	0	78,500	0	78,500	0	
BM	0.001	71,300	71	71,300	71	71,000	71	71,300	71	
D	0.002	100,000	200	100,000	200	98,400	197	100,000	200	
Total			2,427		2,433		2,318		2,435	
LSBH	0.003	77,000	231	76,600	230	75,600	227	76,600	230	2026
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	7,800	31	7,800	31	3,700	15	7,800	31	
C-T	0.005	271,000	1,355	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.002	249,000	498	249,000	498	244,000	488	248,000	496	
SM	0	70,700	0	70,700	0	71,800	0	70,700	0	
BM	0.001	66,300	66	66,300	66	65,400	65	66,300	66	
D	0.002	125,000	250	125,000	250	122,000	244	125,000	250	
Total			2,439		2,450		2,328		2,452	
LSBH	0.003	76,300	229	75,900	228	75,600	227	75,900	228	2036
LSBH	0.005	-	-	-	-	-	-	-	-	
ESBH	0.003	2,600	8	3,300	10	4,800	14	4,800	14	
CU	0.003	0	0	0	0	0	0	0	0	
BH/CT	0.004	8,500	34	8,500	34	3,600	14	8,500	34	
C-T	0.005	271,000	1,355	273,000	1,365	255,000	1,275	273,000	1,365	
C-T	0.006	-	-	-	-	-	-	-	-	
OL	0	81,000	0	80,800	0	106,000	0	80,900	0	
FM	0.002	243,000	486	243,000	486	238,000	476	242,000	484	
SM	0	67,300	0	67,300	0	69,200	0	67,300	0	
BM	0.001	64,400	64	64,400	64	63,200	63	64,400	64	
D	0.002	135,000	270	135,000	270	131,000	262	135,000	270	
Total			2,446		2,457		2,331		2,459	

TABLE F-5-7

ATCHAFALAYA BASIN STUDY
PLAN ALTERNATIVE ASSESSMENT
RECREATION USER DAY SUMMARY WITH ASSOCIATED ANNUAL DOLLAR VALUES

	FWOP		EQ		NED		TS		Recommended	
	User Days		User Days		User Days		User Days		User Days	
Area	1980	2030	1980	2030	1980	2030	1980	2030	1980	2030
Floodway	140,000	89,800	140,000	156,000	140,000	78,700	140,000	156,000	140,000	168,000
Marsh/Backwater	129,000	130,000	129,000	130,000	129,000	126,000	129,000	130,000	129,000	130,000
Floodway/Proposed Rec Plan	0	0	0	1,255,000	0	1,026,000	0	1,255,000	0	1,026,000
Totals	269,000	220,000	269,000	1,541,000	269,000	1,231,000	269,000	1,541,000	269,000	1,324,000

	FWOP		EQ		NED		TS		Recommended	
	Dollar Value		Dollar Value		Dollar Value		Dollar Value		Dollar Value	
Area	1980	2030	1980	2030	1980	2030	1980	2030	1980	2030
Floodway	4,221,000	2,622,000	4,221,000	4,777,000	4,221,000	2,393,000	4,221,000	4,792,000	4,221,000	5,222,000
Marsh/Backwater	3,248,000	3,247,000	3,248,000	3,255,000	3,248,000	3,151,000	3,248,000	3,263,000	3,248,000	3,263,000
Floodway/Proposed Rec Plan	0	0	0	17,273,000	0	16,551,000	0	17,273,000	0	16,551,000
Totals	7,469,000	5,869,000	7,469,000	25,305,000	7,469,000	22,095,000	7,469,000	25,328,000	7,469,000	25,036,000

utilization of regional or site-specific use estimating models; however, the use of either of these methods is contingent upon sufficient base data. No regional use estimating model exists for any area of Louisiana, nor is there a site specific use estimator model (UEM) for the Atchafalaya Basin. Available data on use determining variables were inadequate and were neither time effective nor cost effective to obtain. The application of a similar project's method to derive a UEM for the Atchafalaya Basin was rejected as no similar project exists having adequate surveys and observations from which to extrapolate applicable per capita use rates. As sufficient excess demand was exhibited in the market area, the next preferred method, the capacity method of determining recreation use was employed. The capacity use methodology as it applies to this study is described previously in this section.

F.5.23. Although the existing data was inadequate in providing a basis for forecasting total use, it did serve its intended purpose in providing a basis for determining the site-specific worth of a recreation user day for various activity types. The base data analysis and results are contained in "Recreational Benefits for the Atchafalaya River Basin," F.W. Bell, 1981. This report is detailed in Appendix D. For comparative purposes, the values from Bell's Report (Updated to October 1981 prices), which are in this study, and the value ranges for recreation unit days contained in the WRC Principles and Standards (P&S) are displayed as follows:

	Bell Study ($)	P&S ($)
Bank Fishing	3.14	2.20 - 4.50
Pier Fishing	3.14	2.20 - 4.50
Crabbing	3.14	2.20 - 4.50
Crawfishing	3.14	2.20 - 4.50
General Recreation	7.42	1.50 - 4.50
Boat Fishing	35.79	2.20 - 4.50
Big Game Hunting	40.78	10.50 - 17.90
Small Game Hunting	16.89	2.20 - 4.50
Waterfowl Hunting	26.58	2.20 - 4.50

F.5.24. The total user-days and associated dollar values for each plan alternative are summarized in Table F-5-7. in addition, each plan alternative is addressed with respect to base conditions and compared with the future without-project when impacts due to major project features are assessed.

IMPACT ASSESSMENT AND COMPARATIVE ANALYSIS OF PLANS

Future Without-Project Conditions - Impacts Due to Major Project Features

F.5.25. 1980-2030. Under the future without-project conditions as compared with the 1980 base conditions, 140,000 existing annual recreation user-days would be reduced to 89,800 annual user-days in the floodway, and 129,000 existing annual recreation user-days would be increased to 130,000 annual user-days in the marsh/backwater area by the year 2030. These figures represent annual losses of $1,599,000 and $1,000, respectively. Losses in the floodway can be attributed to the clearing of forested lands for agricultural purposes; and marsh losses can be attributed to the natural process of ongoing marsh deterioration. Under future without-project conditions, a shift in usage from big game hunting to small game hunting will occur. Although an overall gain in user-days would be realized, the unit day value differential would be too great to prevent an overall net annual monetary loss.

F.5.26. 2030. Data are not available to forecast conditions beyond 2030, but if land clearing continues throughout the project life, at least 25,000 additional acres would be cleared by 2080, resulting in an additional loss of 9,500 annual recreation user-days worth $286,000.

EQ Plan - Impacts Due to Major Project Features

F.5.27. 1980-2030. Under this plan, compared with the 1980 base conditions, 140,000 existing annual recreation user-days would be increased to 156,000 annual user-days in the floodway, and 129,000 annual recreation user-days would be increased to 130,000 annual user-days in the marsh/backwater area by the year 2030. These figures represent annual gains of $556,000 and $7,000, respectively, for that year. Increases in the amount of user-days in the floodway can be attributed to the real estate features of the plan, which prevent land clearing and provide for public access to large tracts of prime lands that will be managed to enhance recreation use potential. Increase in the marsh/backwater area can be attributed to the preclusion of clearing of forestlands in the backwater and to vegetative succession of lands to a higher carrying capacity use. When compared with figures for the future without-project conditions (2030), this plan alternative reflects a net annual increase of 66,200 user-days worth $2,155,000 for the floodway and a net annual increase of 300 user-days worth $8,000 for the marsh/backwater area. In addition, the proposed recreational development features of this plan would provide a net increase of 1,237,000 annual user-days for the floodway and 18,000 for the marsh/backwater. The total of these user-days has a combined annual net worth of $17,273,000.

F.5.28. 2030-2080. Data are not available to forecast exact conditions beyond the year 2030, but if trends occurring at that time continue into the future, recreation use potential in the floodway will increase slightly over time through the remaining project life. This increase will result from the natural succession of certain habitat type acreage to a type with higher recreational use potential. Marsh acreage will, however, continue to decline, lowering its associated user-day potentials. Because much land outside the floodway in the region will be cleared for agricultural purposes, the nonconsumptive recreation use potential in the floodway will probably increase because of the nonavailability of the resource elsewhere. Use occurring on the developed recreational features proposed by this plan would remain constant and at optimal design carrying capacity levels, based upon projected market area need for the initial construction year.

NED Plan - Impacts Due to Major Project Features

F.5.29. 1980-2030. Under the NED plan, compared with the 1980 base conditions, 140,000 existing annual recreation user-days would be decreased to 78,700 annual user-days in the floodway, and 129,000 annual user-days would be decreased to 126,000 annual user-days in the marsh/backwater area by the year 2030. These figures represent annual losses of $1,828,000 and $97,000, respectively, for that year. Losses in the floodway can be attributed to extensive clearing of forested lands for agricultural purposes. Marsh/backwater area losses can be attributed to clearing of forested lands for agricultural purposes in the backwater area, to the natural process of ongoing marsh deterioration, and to the Avoca Island levee extension alinement, which would directly interfere with delta development. When compared with figures for the future without-project figures (2030), this plan alternative reflects a net annual decrease of 11,100 user-days worth $229,000 for the floodway, and a net annual decrease of 4,000 user-days worth $96,000 for the marsh/backwater area. The proposed recreational development feature of this plan would occur on fee simple land, maximizing national economic development. A net annual increase of 1,026,000 recreation user-days worth $16,551,000 would be provided. The increases for this plan are less than for other plan alternatives as no visitation is calculated for activities occurring on easement lands which account for 229,000 annual user days in the other plan alternatives.

F.5.30. 2030-2080. Data are not available to accurately forecast conditions beyond the year 2030, but if land clearing continues throughout the remainder of the project life, at least 25,000 additional acres of forestland would be cleared, resulting in an additional loss of 9,500 annual recreation user-days worth $286,000.

TS Plan - Impacts Due to Major Project Features

F.5.31. 1980-2030. Same as discussed under EQ plan.

F.5.32. 2030-2080. Same as discussed under EQ plan.

Recommended Plan - Impacts Due to Major Project Features

F.5.33. 1980-2030. When compared with the 1980 base conditions, the recommended plan would increase 140,000 annual recreation user-days to 168,000 annual recreation user-days in the floodway, and 129,000 annual recreation user-days to 130,000 annual recreation user-days in the marsh/backwater area by the year 2030. These figures represent annual gains of $1,001,000 and $15,000 respectively, for that year. The reasons for these increases are the same as those discussed under the EQ plan. When compared with figures for the future without-project conditions (2030), this plan alternative reflects a net annual increase of 78,200 user days worth $2,600,000 for the floodway and a net annual increase of 500 user-days worth $16,000 for the marsh/backwater area. The impacts of the recreational development plan are identical to those discussed under the NED plan.

F.5.34. 2030-2080. Same as under EQ plan.

Section 6 - RECREATION DEVELOPMENT BENEFIT - COST ANALYSIS

COSTS

F.6.1. A cost estimate summary in 1981 dollars for the initial development of each recreational site as based upon facilities proposed for each site is shown in Table F-6-1. A contingency factor of 25 percent has been included, as well as 12 percent for engineering and design costs, and 13 percent for supervision and administration related to the construction of recreational facilities. Land costs are also included. Two percent of the total first costs, exclusive of land costs, was used for estimating annual operation, maintenance and replacement costs. The operation, maintenance and replacement (O&M) costs will be borne by the local sponsor, which is the State of Louisiana. These costs apply only to the O&M of the recreational facilities proposed for development on the 1,500 acres of proposed fee land. Because of the difficulty in estimating actual O&M costs that would be incurred by the State of Louisiana regarding its manpower capabilities, existing equipment inventories, salary requirements, etc., a 2 percent assessment of the total separable first costs of recreational facilities development, exclusive of land acquisition costs, was used to calculate the estimated annual O&M costs. This 2 percent figure is consistent with approved estimated O&M costs used for other US Army Corps of Engineers' water resource development projects having similar recreational development administered by non-Federal entities. Costs reflected in Table F-6-1 are associated with the development of recreational facilities on land acquired in fee simple and are, therefore, applicable to all plan alternatives being considered, except future without-project conditions.

BENEFITS

F.6.2. To calculate benefits for the recommended recreational development features, user-day values listed in Section 5 of this appendix were applied to projected annual use figures for the activity types of each plan alternative to arrive at an annual total dollar figure. Table F-6-2 shows these computations for all plans under consideration. Plans 4 (EQ) and 9 (TS) are identical in that they accrue benefits from use occurring on both fee and easement land, whereas Plan 7 (NED) and the recommended plan differ from Plans 4 and 9 by incorporating a level of development that can occur only on land purchased in fee simple to maximize national economic development.

TABLE F-6-1

ATCHAFALAYA BASIN STUDY
COST ESTIMATE SUMMARY FOR PROPOSED RECREATIONAL DEVELOPMENT
(DOLLARS IN THOUSANDS)

Site Development Type		Subtotal 1	25% Contingencies	Net Total	12% E&D	13% S&A	Subtotal 2	Real Estate	Grand Total	Annual O&M & Replacement
Campground (Dev)	A	1,747.77	437.23	2,185.00	262.20	284.05	2,731.25			2% of
	B	2,190.75	547.98	2,738.44	328.61	355.99	3,423.04			subtotal 2
	C	1,734.32	433.44	2,167.75	260.25	281.87	2,709.86			
Campground (Prim)	D	91.43	22.77	114.28	13.80	14.84	142.95			
	E	91.43	22.77	114.28	13.80	14.84	142.95			
	F	91.43	22.77	114.28	13.80	14.84	142.95			
	G	91.43	22.77	114.28	13.80	14.84	142.95			
	H	91.43	22.77	114.28	13.80	14.84	142.95			
	I	91.43	22.77	114.28	13.80	14.84	142.95			
	J	91.43	22.77	114.28	13.80	14.84	142.95			
Interpretive Facility	K	560.05	140.30	700.35	84.07	91.08	875.50			
Boat-launching Area two-lane	L	322.00	80.50	402.50	48.30	52.33	503.13			
	M	322.00	80.50	402.50	48.30	52.33	503.13			
Boat-launching Area five-lane	N	402.50	100.63	503.13	60.38	65.55	629.05			
	O	402.50	100.63	503.13	60.38	65.55	629.05			
	P	402.50	100.63	503.13	60.38	65.55	629.05			
	Q	402.50	100.63	503.13	60.38	65.55	629.05			
	R	402.50	100.63	503.13	60.38	65.55	629.05			
	S	402.50	100.63	503.13	60.38	65.55	629.05			
Boat-launching Area two-lane	T	322.00	80.5	402.50	48.30	52.33	503.13			
	U	322.00	80.5	402.50	48.30	52.33	503.13			
Boat-launching Area five-lane	V	402.50	100.63	503.13	60.38	65.55	629.05			
Boat-launching Area two-lane	W	322.00	80.50	402.50	48.30	52.33	503.13			
	X	322.00	80.50	402.50	48.30	52.33	503.13			
	Y	322.00	80.50	402.50	48.30	52.33	503.13			
	Z	322.00	80.50	402.50	48.30	52.33	503.13			
Totals		12,266.36		15,333.41			19,168.61	1,187.00[1/]	20,355.61	383.37

[1/] $1,187,000 is the fee acquisition cost of 1,500 acres excluding comprehensive basin-wide easements. When such easements are assumed in place, the incremental cost of acquiring the 1,500 acres would be $874,000. These figures are used in the cost computations of their associated plan alternative.

TABLE F-6-2

ATCHAFALAYA BASIN STUDY
Dollar Benefit Calculations for Proposed Recreational Features

Recreational Activities	EQ and TS Plans			NED and Recommended Plans		
	Annual Visitation	User Day Value	Dollar Benefits	Annual Visitation	User Day Value	Dollar Benefits
General Recreation	705,468	7.42	5,235,000	705,648	7.42	5,235,000
Fishing (Boat)	315,828	35.79	11,303,000	315,828	35.79	11,303,000
Fishing (Other)	233,997	3.14	735,000	4,230	3.14	13,000
Grand Totals	1,255,293		17,273,000	1,025,706		16,551,000

Therefore, use attributed to those activities occurring on nonfee land is precluded from the NED plan and the recommended plan, and user-days and benefits will be deducted for these activities under these plan alternatives.

BENEFITS AND COSTS

F.6.3. For the EQ and TS plans, the following benefit-cost computations are applicable:

Total First Cost of Construction	$21,571,000[1/]
Interest and Amortization Factor (100-year, 7-5/8 percent)	0.0763
Annual Interest and Amortization	$ 1,645,867
Annual Interest and Amortization	$ 1,646,000 (rounded)
Annual Operational and Maintenance Costs	383,000
Total Annual Costs	$ 2,029,000
Annual Benefits	$17,273,000
Annual Costs	$ 2,029,000 = 8.5 to 1

F.6.4. The benefit-cost ratio of the proposed recreational development features of the EQ and TS plans is 8.5 to 1.

F.6.5. For the NED plan, the following computations are applicable:

Total First Cost of Construction	$21,908,000[2/]
Interest and Amortization Factor (100-year, 7-5/8 percent)	0.0763
Annual Interest and Amortization	$ 1,671,580
Annual Interest and Amortization	$ 1,672,000 (rounded)
Annual Operation and Maintenance Costs	383,000
Total Annual Costs	$ 2,055,000
Annual Benefits	$16,551,000
Annual Costs	$ 2,055,000 = 8.1 to 1

1/ Includes $1,528,000 for interest during construction.
2/ Includes $1,552,000 for interest during construction.

F.6.6. The benefit-cost ratio of the proposed recreational development features of the NED plan is 8.1 to 1.

F.6.7. For the recommended plan, the following computations are applicable:

Total First Cost of Construction	$21,571,000[1/]
Interest and Amortization Factor (100-year, 7-5/8 percent)	0.0763
Annual Interest and Amortization	$ 1,645,867
Annual Interest and Amortization	$ 1,646,000 (rounded)
Annual Operational and Maintenance Costs	383,000
Total Annual Costs	$ 2,029,000
Annual Benefits	$16,551,000
Annual Costs	$ 2,029,000 = 8.2 to 1

F.6.8. The benefit-cost ratio of the proposed recreational development features of the recommended plan is 8.2 to 1.

F.6.9. These benefit-cost ratios are derived solely for the proposed recreational development features of each plan alternative. There are, however, other recreation benefits or losses that occur from shifts in land-use caused by the other varying features of each plan alternative. These recreation benefits or losses have been identified and monetarily calculated in Section 5 of this appendix addressing plan alternative assessment; however, recreation impacts are only one of several impacts attributable to the various features of a respective plan alternative and cannot be considered apart from the other impacts of that plan, nor can they generate a benefit-cost ratio.

[1/] Includes $1,528,000 for interest during construction.

Section 7 - RECREATION AND RESOURCE MANAGEMENT

MANAGEMENT RESPONSIBILITIES

F.7.1. All costs associated with acquiring real estate interests and with constructing the initial recreation facilities development as proposed herein for the Atchafalaya Basin floodway project will be at 100-percent Federal expense, provided that the State of Louisiana assumes all costs for management, administration, operation, maintenance, and future replacements. Revenues generated through campground user fees, entrance fees, or other incidental fees associated with operation of developed public recreation facilities, public access areas, and supporting third-party concessions will be retained by the state under appropriate lease agreement, subject to Federal regulations and reporting requirements, to help defray expenses for operations, maintenance, and replacements. Also, revenues generated through timber harvesting solely for the purpose of improving wildlife habitat on forested lands that may be under Federal ownership, as defined in appropriate license agreement, will be retained by the state for use in the development, conservation, maintenance, and utilization of such lands for fish and wildlife purposes.

F.7.2. All costs for constructing and maintaining offices, shops, storage, or other buildings, and for operations and maintenance including, but not limited to, automobiles, utility vehicles, trucks, boats, tools, machinery, heavy and light construction equipment, fences, signs, roads, parking areas, utilities, potable water and sanitary systems, and any other physical plant, personnel, or equipment incidental to or associated with the management, administration, operation, maintenance, and replacement of developed public recreation facilities and public land and water resources in the Atchafalaya Basin will be borne by the State of Louisiana.

COST SHARING

F.7.3. For purposes of determining Federal-state cost-sharing responsibilities, the Atchafalaya Basin is not a traditional water resources development project. Thus, the project should be considered exempt from the traditional policies, the President's cost-sharing policy, and provisions of PL 89-72, 89th Congress, S. 1229, 9 July 1965 under Section 6(e), which states in part that

"cost-sharing and reimbursement provisions of the Act shall not apply to nonreservoir local flood control projects," beach erosion control projects, small boat harbor projects, hurricane protection projects, "or to project areas or facilities authorized by law for inclusion within a national recreation area or appropriate for administration by a Federal agency" as part of a national forest system, as part of the public lands classified for retention in Federal ownership, "or in connection with an authorized Federal program for the conservation and development of fish and wildlife." The pre-authorization study was authorized by both the House of Representatives and the Senate of the United States, as cited under Study Authority in Appendix A, i.e., "developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin, Louisiana, which would include...improvements of the area for commercial and sport fishing..."

F.7.4. The Atchafalaya Basin floodway is a nonreservoir flood control project, but goes far beyond the scope of a local project. The project areas or facilities may become authorized by law to satisfy the intent of the study authority resolution, which directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport fishing, as well a commercial fishing potential. The nonflood control aspects of the project are considered appropriate for administration by a Federal or state agency. In view of the administrative policy of placing more responsibility for the operation and maintenance of water resource projects in the hands of local authorities, it is proposed that the State of Louisiana take responsibility for operation and maintenance of management units, recreational development and any lands acquired for public access. Flood control features, dredge and fill (404 and Section 10), and real estate management of Federally acquired rights or interests will remain under the control of the US Army Corps of Engineers through appropriate license or lease agreements with the state.

F.7.5. Lands of the Atchafalaya Basin are not part of a national forest system. However, further justification for exemption of the Atchafalaya Basin floodway from cost-sharing requirements may be based on the basin's national environmental prominence as the largest existing forested wetland (river swamp) in the United States today that remains in a semi-natural state. The charge for preservation of this vast national resource, while maximizing public opportunity to observe and use its fish and wildlife resources, is clearly beyond the scope of traditional US Army Corps of Engineers' water resource development projects. The Governor of the State of Louisiana, in the state's Land Use Proposal, transmitted by letter 5 November 1980 to the District Engineer, recommended that "...management of nonflood control elements of the final Atchafalaya Basin plan should be through State of Louisiana agencies". This appears to more than satisfy previous legislative and executive intent for assuring local cooperation and participation in Federal flood control projects.

RECREATIONAL LANDS AND FACILITIES

F.7.6. Section 221 of the Flood Control Act of 1970 requires that the construction of any water resources project by the Secretary of the Army acting through the Chief of Engineers, shall not be commenced until each non-Federal interest has entered into a written agreement with the Secretary of the Army to furnish its required cooperation for the project. Consistent with this section of the Act, it is the intent of the District Engineer to lease all lands acquired for recreational development purposes in the Lower Atchafalaya Basin floodway project to the State of Louisiana for the purpose of administration, operation, maintenance, replacement, and future development to fulfill that cooperative requirement. The previously alluded to Land Use Proposal letter of 5 November 1980, from the Governor of the State of Louisiana, will serve as the letter of intent for assuring local cooperation and participation in the management of nonflood control elements of this Federal flood control project. A copy of the referenced letter is contained as an inclosure in Appendix B.

F.7.7. Terms and conditions of the lease(s) shall be in accordance with policies and procedures under statutory authority of Section 4 of the Act of Congress, approved 22 December 1944, as amended (16 U.S.C. 460-d).

F.7.8. The consideration for such lease(s) is the assumption by the state of the obligations imposed by terms of the lease to provide the services and facilities required to serve the general public in the leased area(s).

OTHER LANDS

F.7.9. For other lands on which Federal easements are acquired in the Atchafalaya Basin floodway project, it is the intent of the District Engineer to license such lands to the State of Louisiana for management, operation, and maintenance for public interests other than public park and recreational purposes.

F.7.10. Terms and conditions of the license(s) shall be in accordance with policies and procedures under statutory authority of Section 4 of the Act of Congress, approved 22 December 1944, as amended (76 Stat. 1195; 16 U.S.C. 460-d). The Fish and Wildlife Coordination Act and the Act of 22 December 1944, as amended, will both be invoked for the grant of a license for fish and wildlife management as well as forest management.

F.7.11. Monetary consideration is not required for the granting of such license.

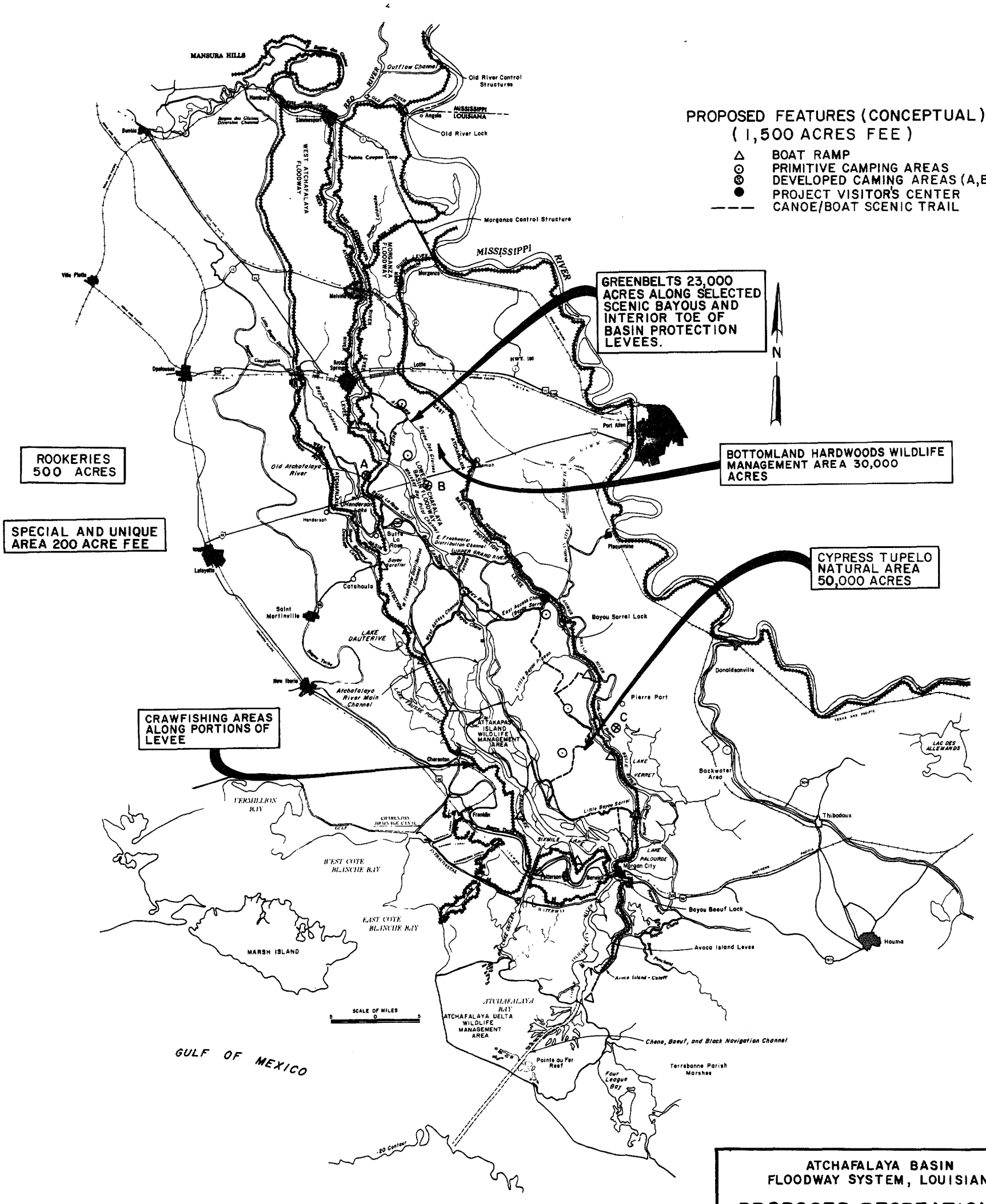
MANAGMENT ENTITY, STATE

F.7.12. Under the envisioned state management concept, several different state departments will have responsibilities within the Lower Atchafalaya Basin floodway for administration, operations, and maintenance of the basin's developed and natural resources. Thus, the state should consider establishing a single management entity or authority, sufficiently staffed to effectively coordinate all the various departmental efforts, i.e., planning, budgeting, designing, constructing, operating, and maintaining the various support elements of the comprehensive plan. It is also recommended that the state establish a subordinate law enforcement entity with police powers and arrest authority to adequately control and protect all public and private use and natural resource features of the basin.

F.7.13. A notable amount of trash, litter, and other refuse dumping now occurs in the Lower Atchafalaya Basin Floodway. With implementation of the proposed plan to increase public access and to expand developed public recreational facilities in the floodway, this problem will likely become more serious than exists at present. For this reason, early consideration should be given the problem during formulation of the state management entity. Measures that might be considered for early implementation include: periodic (weekly or more often) cleanup of recreational areas by operations and maintenance personnel; anti-litter public cleanup campaigns; provision of adequate law enforcement surveillance supported by enforceable litter and dumping laws; and the seasonal or rotational closing of certain recreational areas to public use during low visitation periods of the year.

MANAGEMENT, OTHER FEDERAL AGENCIES

F.7.14. The District Engineer will be the sole jurisdictional authority to protect and oversee Federal interests in the Atchafalaya Basin floodway system upon implementation of the comprehensive plan. However, the District Engineer will continue to coordinate with other Federal agencies on collateral interests as required by Federal law and US Army Corps of Engineers' regulations.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

PROPOSED RECREATIONAL DEVELOPMENT PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE F-1

PLATE F-1

APPENDIX G

FISH AND WILDLIFE AND RELATED DATA

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Appendix G

FISH AND WILDLIFE AND RELATED DATA

G.0.1. This report contains a variety of information and data that either supplements data presented in the main report/EIS and other appendixes, or serves to explain how certain data presented in those documents were derived. Included are discussions of fish and wildlife habitat evaluation, mitigation needs, land use projections, desired hydrographs, Section 404 findings and a rationale for determination of marsh deterioration with and without the Avoca Island levee extension. Certain tabular material such as the Audubon Society "blue list," lists of scientific names of plants, and direct construction impacts of levee raising are also included.

Section 1 - AQUATIC HABITAT EVALUATION

G.1.1. The Habitat Evaluation System (HES), a method of evaluating the value of various habitat types for fish and wildlife productivity, has been developed by the US Army Corps of Engineers, Lower Mississippi Valley Division (US Army Corps of Engineers, 1980). This system is used as an aid in planning water resources projects and in determining resulting mitigation needs. The system can be used to estimate the value of lakes, rivers and bayous. However, it does not include a method of evaluating the worth of flooded forest land to the aquatic ecosystem. Since a great deal of hydrologic and land use data exist for the Lower Atchafalaya Basin Floodway (LABF), a method of rating flooded forest lands has been developed by New Orleans District (NOD), Corps of Engineers, and will be described subsequently. Since only limited fishery data exist for the backwater area northeast of Morgan City and since no marsh aquatic HES methodology exists, a decision was made to limit the aquatic HES to the LABF.

Standard Aquatic HES

ACREAGE

G.1.2. For 1980 conditions and all subsequent decades, land use data developed by NOD in January 1981 were utilized. Only acres within the LABF were used. The future without-project condition includes levee raising by local interests. Thus, it was necessary to develop a true future without project that does not include the impacts of levee construction in order to fully evaluate project impacts. According to 33 CFR 230, Appendix A paragraph 6e(4), it is necessary to determine mitigation needs for such non-Federal action included in the future without project condition. To determine the direct construction impacts of levee raising in the LABF, only the floodside borrow pits were considered because landside pits would not be in the LABF.

HES VALUES

G.1.3. Bryan, et al. (1974, 1975, 1976), conducted fishery studies in the Atchafalaya Basin from 1973 to 1976. The data developed in these studies were utilized to prepare the field HES sheets.

G.1.4. Headwater Lakes. Since fish standing crop data have been collected (Sabins 1977), the parameters considered for headwater lakes

were reweighted to make total dissolved solids, flooding index, and sport fish standing crop of equal and highest value. Depth, chemical type, turbidity, and total standing crop were of equal but lesser value. Table G-1-1 shows weights of each parameter as well as values from the field sheets. In plans that include clearing for agriculture, turbidity and pesticides would increase dramatically, and it was assumed that the habitat quality index (HQI) would be reduced by 15 percent over 50 years. In plans with no clearing, the HQI was assumed to remain constant over the life of the project.

G.1.5. Backwater Lakes. Bryan, et al. (1974, 1975, 1976), collected little or no data in backwater lakes in the LABF. The one lake studied in the Upper Basin had a HQI value of 0.86, using the reweighted parameters described above. Parameters were made up for a hypothetical LABF backwater lake (Table G-1-2), assuming turbidity was less than that in headwater lakes and that spring flooding was greater than that in an Upper Basin backwater lake. Standing crop values from Lantz (1974) for Henderson Lake were used. It was assumed that plans with clearing would decrease HQI values by 15 percent over 50 years due to increases in pesticides and turbidity. HQI values were assumed to stay constant in plans without clearing.

G.1.6. Cropland Lake. Bryan, et al. (1974, 1975, 1976), had data for three such lakes: two in the Upper Basin and one in the LABF. Since standing crop data for these lakes were available from Sabins (1977), the parameters were reweighted in a manner similar to those for headwater lakes (Table G-1-3). Values from Bryan, et al. (1974, 1975, 1976), were utilized for chemical parameters. Since clearing in the Upper Basin is fairly recent, it was assumed that HQI values for cropland lakes were not as low as possible now. Thus, in plans with clearing the value was assumed to decrease by 5 percent over 50 years, mainly due to the effects of pesticides.

G.1.7. Riverine and Distributary Habitat. Values from Bryan, et al. (1974, 1975, 1976), were utilized. See Table G-1-4 for HQI values. In future projections, a 10-percent loss in HQI values was assumed for plans with clearing. Since this habitat type is highly turbid, the increased turbidity caused by clearing should not have as much impact as in other habitats. The HQI values remained constant in plans with no clearing.

G.1.8. Bayous and Slow-Flowing Canals. Values from Bryan, et al. (1974, 1975, 1976), were used to prepare the field sheets. The waters south of Buffalo Cove (LSU sites WC and WG) were considered to be bayous. See Table G-1-5 for HQI values of various sites. In the future, it was assumed that a 15-percent loss in HQI would occur in plans with clearing. This 15-percent loss would reduce the HQI value to 0.68 by 2030. This compares well to the 0.66 HQI value of upper basin bayous at present. The lower basin bayous should rate slightly higher because they would receive riverine overflow.

TABLE G-1-1

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR HEADWATER LAKES

PARAMETER	WEIGHT	SAMPLE STATIONS											
		DUCK LAKE		FLAT LAKE		LSU WB		LSU WD		LSU WE		LSU WF	
		DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE
Total Dissolved Solids (mg/l)	17	191	17	192	17	186	17	203	17	184	17	198	17
Spring Flooding Index	17	120,000	17	100,000	17	144,000	17	72,000	17	72,000	17	108,000	17
Mean Depth (feet)	11	13.0	11	9.5	10.6	7.5	8.3	12.1	11	8.4	9.2	8.5	9.2
Chemical Type	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11
Turbidity (JTU)	11	39.0	11	31.0	10.8	63.0	10.9	47.0	11.0	50.0	11	68.0	10.8
Shoreline Development Index	5	1.6	0.6	1.4	0.5	2.0	0.7	2.4	0.9	2.4	0.9	3.1	1.2
Total Fish Standing Crop (lbs/A)	11	414	9.7	414	9.7	414	9.7	414	9.7	414	9.7	414	9.7
Sport Fish Standing Crop (lbs/A)	17	119	17	119	17	119	17	119	17	119	17	119	17
Habitat Quality Index[1/]			0.94		0.94		0.92		0.95		0.93		0.93

[1/] Mean HQI for all stations equalled 0.94 with a standard deviation of 0.01.

TABLE G-1-2

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR BACKWATER LAKES

		Sample Stations			
		LOWER BASIN HYPOTHETICAL		PETITE PRAIRIE #2	
PARAMETER	WEIGHT	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE
Total Dissolved Solids (mg/l)	17	150	17	158	17
Spring Flooding Index	17	30,000	17.0	1,560	11.9
Mean Depth (feet)	11	7.0	7.9	6.0	6.4
Chemical Type	11	$CaMgCO_3$	11	$CaMgCO_3$	11
Turbidity (JTU)	11	17.0	10.5	21.5	10.6
Shoreline Development Index	5	4.0	1.4	4.7	1.7
Total Fish Standing Crop (lbs/A)	11	362	10.6	362	10.6
Sport Fish Standing Crop (lbs/A)	17	134	17	154	17
Habitat Quality Index (HQI)[1/]			0.90		0.86

[1/] Mean HQI for all station equalled 0.88 with a standard deviation of 0.03.

TABLE G-1-3

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR CROPLAND LAKES

		Sample Stations					
		BIG ALABAMA		PETITE PRAIRIE #4		PETITE PRAIRIE #1	
PARAMETER	WEIGHT	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE	DATA	WEIGHTED SCORE
Total Dissolved Solids (mg/l)	17	100	13.6	215	17.0	210	17.0
Spring Flooding Index	17	1,650	11.9	1,560	11.9	1,320	11.2
Mean Depth (feet)	11	13	11.0	8.2	9.0	13	11.0
Chemical Type	11	$CaMgCO_3$	11	$CaMgCO_3$	11	$CaMgCO_3$	11
Turbidity (JTU)	11	25	10.7	25	10.7	17	10.5
Shoreline Development Index	5	2.32	.85	4	1.4	2.9	1.1
Total Fish Standing Crop (lbs/A)	11	495	8.8	495	8.8	495	8.8
Sport Fish Standing Crop (lbs/A)	17	20	6.1	20	6.1	20	6.1
Habitat Quality Index HQI[1/]			0.74		0.76		0.77

[1/] Mean HQI for all stations equalled 0.76 with a standard deviation of 0.02.

TABLE G-1-4

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR RIVERINE HABITAT

PARAMETER	WEIGHT	Sample Stations LSU RA DATA	LSU RA WEIGHTED SCORE	LSU RB DATA	LSU RB WEIGHTED SCORE
Species Association	30	rough +	9.0	rough +	9.4
Sinuosity Index	20	1.1	5.6	1.1	5.4
Total Dissolved Solids (mg/l)	20	190	20	222	20
Turbidity (JTU)	10	95	6.4	84	7.2
Chemical Type	10	$CaMgCO_3$	10	$CaMgCO_3$	10
Benthic Diversity Index	10	1.8	5	3.6	9.9
Habitat Quality Index (HQI)[1/]			0.56		0.62

[1/] Mean HQI for all stations equalled 0.59 with a standard deviation of 0.04.

TABLE G-1-5

HABITAT EVALUATION SYSTEM FIELD DATA SUMMARY FOR BAYOUS

PARAMETER	WEIGHT	SAMPLE STATIONS: LOWER BASIN LSU WG DATA	LSU WG WEIGHTED SCORE	LSU WG DATA	LSU WG WEIGHTED SCORE	LSU EB DATA	LSU EB WEIGHTED SCORE	BIG PIGEON DATA	BIG PIGEON WEIGHTED SCORE	UPPER BASIN STATE CANAL DATA	UPPER BASIN STATE CANAL WEIGHTED SCORE
Species Association	30	LMB/BC[2/]	24	LMB/BC	24	LMB/BC	24	LMB/BC	24	BC/WAR[3/]	12
Sinuousity Index[1/]	20	1.2	10	1.2	10	1.2	10	1.2	10	1.2	10
Total Dissolved Solids (mg/l)	20	182	20	190	20	214	20	256	20	177	20
Turbidity (JTU)	10	66	8.4	68	8.3	48	9.3	64	8.4	33	9.8
Chemical Type	10	$CaMgCO_3$	10	$CaMgCO_3$	10	$CaMgCO_3$	10	$CaMgCO_3$	10	$CaMgCO_3$	10
Benthic Diversity Index	10	1.8	5	1.8	5	4.4	10	3.1	9	1.6	4.2
Habitat Quality Index (HQI)[4/]			0.77		0.77		0.83		0.81		0.66

1/ Sinuosity was exceedingly low at two LSU sites and exceptionally high at a third. Average sinuosity was measured at random for several bayous; it was 1.2.

2/ Largemouth bass, bluegill, crappie

3/ Bluegill, crappie, warmouth

4/ Mean HQI for all stations equalled 0.77 with a standard deviation of 0.07.

Aquatic HES for Flooded Forest

G.1.9. Since much of the aquatic productivity in the LABF depends on seasonally flooded woodlands, it was necessary to evaluate the quality of such habitat and to project changes over the project life.

ACREAGE

G.1.10. The peak of the average shifted stage hydrograph (ASSH) was noted for each management unit (see Appendix C). The number of acres of each forest type flooded at the peak of the hydrograph was determined from 1980 stage area curves. To estimate 2030 conditions, the acres of each habitat type below the projected flood-free 3 years out of 5 elevation were determined from the appropriate stage area curves. Then since about 80 percent of the acres above the flood-free 3 out of 5 elevation were estimated to be cleared in the NED plan, 20 percent of the acres between the flood-free peak and the ASSH peak were assumed to be flooded forest. This 20 percent was added to the acres below the flood-free peak to get the total flooded forest in 2030 for the NED plan. In the EQ and tentatively selected plans, the entire acreage below the 2030 ASSH peak was determined to be flooded. In the management units that are proposed for implementation, the peak of the achievable hydrograph was used (see Appendix C). Once the number of flooded forest acres was known for 1980 and 2030, the percent this was of the whole forest acreage for these years was calculated. Then since the hydrograph peaks drop in a linear fashion, it was possible to extrapolate the percentage of flooded forest for each habitat type by decade. These percentages were then applied to the total acreage for each habitat type. To estimate direct construction impacts in flooded forest, the impacts of levee raising for the West Atchafalaya Basin Protection Levee (WABPL) were subtracted from flooded early and late successional forests in 1990 and all subsequent years. Much of the bottomland hardwood forest adjacent to the East Atchafalaya Basin Protection Levee (EABPL) is at a high elevation and is not flooded on the ASSH. In cypress-tupleo, impacts of levee raising from both the WABPL and EABPL were subtracted from 1990 and subsequent years. Since the HES base must not consider any levee raising prior to 1980, all impacts are subtracted from 1990 so that mitigation could be accomplished.

HES VALUES

G.1.11. It was decided that the most important parameter in determining the value of flooded forests to the aquatic ecosystem was the duration of flooding. Crawfish use the flooded forests in March and April, and buffalo spawn there. Shad, crappie, and gar are spring spawners, and their young utilize the flooded forests for nursery areas. A second factor that makes flooded forests valuable to the aquatic ecosystem is the production of ground cover and understory. Conner and Day (1976) showed that understory and ground cover were responsible for 40 percent of the non-tree biomass in wet bottomland hardwoods. These wet bottomland hardwoods produce the maximum amount of herbaceous ground cover if water is off them by the end of May or early June.

G.1.12. The average shifted stage hydrographs were utilized to determine the stages at which the various management units were flooded for varying lengths of time. Table G-1-6 shows the weights allocated to each period of flooding by habitat type and the time by which the water would be off the woods for each period. The basic rationale behind the weighting for late successional bottomland hardwoods was that optimal conditions would be to have no flooding later than 1 June. Flooding over 5.5 months was considered to be of little value to the aquatic system, since very little ground cover would be produced in such cases. Since early successional bottomland hardwoods generally have less herbaceous ground cover than late successional forests, they were weighted less than late successional and the optimal flooding period was again 2.5 to 3.5 months. The main contribution of cypress-tupelo is as aquatic habitat; therefore, the optimal flooding period was considered to be 5.5 to 6.5 months. Flooding would occur on some areas after 1 August, but dissolved oxygen conditions would be very poor; therefore, no value was assigned to these periods.

TABLE G-1-6

WEIGHTS APPLIED TO VARIOUS PERIODS OF FLOODING

Period of Flooding (Months)	Weights			Average Date Water is Removed from woods
	Late Successional Bottomland Hardwood	Early Successional Bottomland Hardwood	Cypress Tupelo	
1.5-2.5	0.8	0.6	0.3	12 May
2.5-3.5	1.0	0.8	0.6	26 May
3.5-4.5	0.7	0.7	0.7	11 June
4.5-5.5	0.5	0.5	0.8	01 July
5.5-6.5	0	0	1	07 July
6.5-7.5	0	0	0.9	15 July
7.5-8.5	0	0	0.3	25 July

G.1.13. These weights are basically individual HQI values for each habitat type for specific periods of flooding. To determine the general HQI for a habitat type, the number of acres flooded for each specific period in each management unit were multiplied by the weight for that period to get the total weighted acres per management unit. This acreage was summed by habitat type and then divided by the total wet acreage of each habitat type so that the HQI value of an individual acre could be determined. The HQI values of each habitat type are shown in Tables G-1-7 to G-1-10.

Habitat Evaluation Analysis

G.1.14. For each plan, the acreage and HQI value for each habitat type by 10-year increments was compared to the similar value for future without project conditions (Tables G-1-7 to G-1-10). Similar habitat types were combined in order to simplify the mitigation calculations. Thus, riverine habitat and bayous; all lake types; and all flooded forests were combined. Table G-1-11 indicates the annualized habitat units lost or gained by combined habitat types.

TABLE G-1-7

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality Index (HQI) by Years
FWO

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
	(HQI)	.59	.578	.578	.566	.566	.554	.554	.543	.543	.531	.531
Bayous and slow-flowing canals [1]	(Acres)	9.8	9.8	15.1	9.8	15.1	9.8	15.1	9.8	15.1	9.8	15.1
	(HQI)	.80	.776	.776	.752	.752	.728	.728	.704	.704	.68	.68
Headwater lakes	(Acres)	17.7	14.4	14.4	11.2	11.2	7.8	7.8	4.6	4.6	1.3	1.3
	(HQI)	.935	.907	.907	.879	.879	.851	.851	.823	.823	.795	.795
Backwater lakes	(Acres)	13.8	12.7	21.7	10.6	10.6	7.8	7.8	6.8	6.8	5.9	5.9
	(HQI)	.90	.873	.873	.846	.846	.819	.819	.792	.792	.765	.765
Cropland lakes	(Acres)	0.03	0.3	0.3	1.6	1.6	3.7	3.7	3.9	3.9	4.1	4.1
	(HQI)	.76	.752	.752	.745	.745	.737	.737	.730	.730	.722	.722
Late Successional Bottomland hardwoods flooded by ASSH [2]	(Acres)	128.0	139.5	136.4	116.1	113.0	83.0	79.9	74.3	71.1	69.9	66.8
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Early Successional Bottomland hardwoods flooded by ASSH [3]	(Acres)	73.3	52.9	50.3	50.9	46.7	45.6	40.0	41.3	33.9	30.0	29.1
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Cypress-tupelo [4] flooded by ASSH	Acres)	173.0	167.9	163.6	166.1	163.8	158.4	156.0	152.6	150.2	148.3	145.9
	(HQI)	.55	.539	.539	.528	.528	.517	.517	.506	.506	.495	.495

[1] Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
[2] Average shifted stage hydrograph.
[3] Includes composition unknown acres.
[4] Includes bottomland hardwood mixed with cypress-tupelo.

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TABLE G-1-8

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality Index (HQI) by Years
EQ Plan

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.0	23.0	23.9	23.0	23.9	23.0	23.9	23.0	23.9
	(HQI)	.59	.578	.59	.566	.59	.554	.59	.543	.59	.531	.59
Bayous and slow-flowing canals[1/]	(Acres)	9.8	9.8	13.9	9.8	13.9	9.8	13.9	9.8	13.9	9.8	13.9
	(HQI)	.80	.776	.80	.752	.80	.728	.80	.704	.808	.68	.80
Headwater lakes	(Acres)	17.7	14.4	14.7	11.2	11.7	7.8	8.6	4.6	5.5	1.3	2.6
	(HQI)	.935	.907	.935	.879	.935	.851	.935	.823	.935	.795	.935
Backwater lakes	(Acres)	13.8	12.7	13.0	10.6	12.3	7.8	11.6	6.8	10.8	5.9	10.1
	(HQI)	.90	.873	.90	.846	.90	.819	.90	.792	.90	.765	.90
Cropland lakes	(Acres)	0.03	0.3	0.03	1.6	0.03	3.7	0.03	3.9	0.03	4.1	0.03
	(HQI)	.76	.752	.76	.745	.76	.737	.76	.730	.76	.722	.76
Late Successional Bottomland hardwoods flooded by ASSH[2/]	(Acres)	128.0	139.5	126.0	116.1	113.3	83.0	100.0	74.3	87.8	69.9	75.0
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Early Successional Bottomland hardwoods flooded by ASSH[3/]	(Acres)	73.3	52.9	51.8	50.9	51.6	45.6	47.9	41.3	44.6	30.0	40.3
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Cypress-tupelo[4/] flooded by ASSH	Acres)	173.0	167.9	164.0	166.1	157.3	158.4	150.8	152.6	144.3	148.3	138.0
	(HQI)	.55	.539	.55	.528	.55	.517	.55	.506	.55	.495	.55

[1/] Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
[2/] Average shifted stage hydrograph.
[3/] Includes composition unknown acres.
[4/] Includes bottomland hardwood mixed with cypress-tupelo.

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TABLE G-1-9

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality (HQI) by Years
NED Plan

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.5	23.0	23.5	23.0	23.5	23.0	23.5	23.0	23.5
	(HQI)	.59	.578	.578	.566	.566	.554	.554	.543	.543	.531	.531
Bayous and slow-flowing canals[1/]	(Acres)	9.8	9.8	13.6	9.8	13.6	9.8	13.6	9.8	13.6	9.8	13.6
	(HQI)	.80	.776	.776	.752	.752	.728	.728	.704	.704	.68	.68
Headwater lakes	(Acres)	17.7	14.4	14.4	11.2	11.2	7.8	7.8	4.6	4.5	1.3	1.3
	(HQI)	.935	.907	.907	.879	.879	.851	.851	.823	.823	.795	.765
Backwater lakes	(Acres)	13.8	12.7	1.27	10.6	10.2	7.8	7.8	6.8	6.3	5.9	5.2
	(HQI)	.90	.873	.873	.846	.846	.819	.819	.792	.792	.765	.765
Cropland lakes	(Acres)	0.03	0.3	0.4	1.6	2.0	3.7	3.8	3.9	4.6	4.1	4.9
	(HQI)	.76	.752	.752	.745	.745	.737	.737	.730	.730	.722	.722
Late Successional Bottomland hardwoods flooded by ASSH[2/]	(Acres)	128.0	139.5	134.3	116.1	108.6	83.0	76.7	74.3	59.7	69.9	57.3
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Early Successional Bottomland hardwoods flooded by ASSH[3/]	(Acres)	73.3	52.9	51.8	50.9	49.5	45.6	43.1	41.3	37.8	37.0	33.3
	(HQI)	.27	.265	.265	.259	.259	.254	.254	.248	.248	.243	.243
Cypress-tupelo[4/] flooded by ASSH	Acres)	173.0	167.9	162.3	166.1	151.6	158.4	137.3	152.6	125.8	148.3	116.0
	(HQI)	.55	.539	.539	.528	.528	.517	.517	.506	.506	.495	.495

1/Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
2/Average shifted stage hydrograph.
3/Includes composition unknown acres.
4/Includes bottomland hardwood mixed with cypress-tupelo.

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TABLE G-1-10

AQUATIC HABITAT EVALUATION SYSTEM
Acres (thousands) and Habitat Quality Index (HQI) by Years
Recommended Plan

Habitat Type		1980 Base Condition	1990 Without Project	1990 With Project	2000 Without Project	2000 With Project	2010 Without Project	2010 With Project	2020 Without Project	2020 With Project	2030 Without Project	2030 With Project
River and distributary	(Acres)	23.0	23.0	23.8	23.0	23.0	23.0	23.8	23.0	23.8	23.0	23.8
	(HQI)	.59	.578	.59	.566	.566	.554	.59	.543	.59	.531	.59
Bayous and slow-flowing canals 1/	(Acres)	9.8	9.8	13.7	9.8	13.7	9.8	13.7	9.8	13.7	9.8	13.7
	(HQI)	.80	.776	.80	.752	.80	.728	.80	.704	.80	.68	.80
Headwater lakes	(Acres)	17.7	14.4	14.7	11.2	11.7	7.8	9.6	4.6	5.5	1.3	2.5
	(HQI)	.935	.907	.935	.879	.935	.851	.935	.823	.935	.795	.935
Backwater lakes	(Acres)	13.8	12.7	13.0	10.6	12.3	7.8	11.6	6.8	10.8	5.9	10.1
	(HQI)	.90	.873	.90	.846	.90	.819	.90	.792	.90	.765	.90
Cropland lakes	(Acres)	0.03	0.3	0.03	1.6	0.03	3.7	0.03	3.9	0.03	4.1	0.03
	(HQI)	.76	.752	.76	.745	.76	.737	.76	.730	.76	.722	.76
Late Successional Bottomland hardwoods flooded by ASSH 2/	(Acres)	128.0	139.6	126.1	116.1	113.4	83.0	100.6	74.3	88.0	70.0	75.2
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Early Successional Bottomland hardwoods flooded by ASSH 3/	(Acres)	73.3	52.9	52.5	50.9	41.9	45.6	50.4	41.3	48.2	37.0	45.1
	(HQI)	.27	.265	.27	.259	.27	.254	.27	.248	.27	.243	.27
Cypress-tupelo 4/ flooded by ASSH	Acres)	173.0	167.9	163.9	166.1	157.2	158.4	150.7	152.6	144.2	148.3	137.9
	(HQI)	.55	.539	.55	.528	.55	.517	.55	.506	.55	.495	.55

1/Direct construction impacts of floodside levee raising were added to bayous and subtracted from forested wetlands for 1990 and carried through 2030.
2/Average shifted stage hydrograph.
3/Includes composition unknown acres.
4/Includes bottomland hardwood mixed with cypress-tupelo.

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TABLE G-1-11

ANNUALIZED HABITAT UNITS LOST OR GAINED[1/]

Habitat Type	Plan 2 FWO	Plan 4 EQ	Plan 7 NED	Plan 9 TSP
Riverine and bayou	+3,509	+4,684	+2,770	+4,470
Lakes	0	+1,714	+32	+2,017
Flooded forest	-3,016	+7,192	-8,470	+7,176

1/ Figures for flooded forest are adjusted to show the contribution due to the widening of the Wax Lake overbank area which was not calculated in the initial computations made using the data in tables G-1-7 through G-1-10.

Section 2 - TERRESTRIAL WILDLIFE HABITAT EVALUATION FIELD METHODOLOGY

G.2.1. Two habitat evaluation techniques were used to evaluate possible impacts of the future without-project condition and the three final plans and to calculate mitigation needs.

G.2.2. Evaluation of most terrestrial habitats was carried out using a slightly modified version of the HES methods developed by the US Army Corps of Engineers, Lower Mississippi Valley Division (US Army Corps of Engineers 1980). A total of 37 terrestrial sites were studied within the project affected areas of the Lower Atchafalaya Basin floodway and the backwater area northeast of Morgan City (Figure G-2-1).

G.2.3. Marsh habitats were evaluated using an experimental technique, being developed by the US Army Corps of Engineers, New Orleans District, which is similar to the HES. This method, which will be referred to as the Marsh Evaluation Technique (MET), was applied to 21 sites located within the marshlands to the south of Morgan City (Figure G-2-1).

G.2.4. Both of these methods are based upon the assumption that the presence or absence, and the abundance and diversity of animal populations in a habitat are determined by basic biotic and abiotic factors that can be readily quantified (US Army Corps of Engineers 1980). By varying these factors, the value of the habitat for fish or wildlife is rated on a scale from 0 to 1.

Habitat Evaluation System HES

G.2.5. Evaluation of 44 terrestrial plots located within the Lower Atchafalaya Basin Floodway and the backwater area northeast of Morgan City was carried out during the summer and fall of 1980 and the early winter of 1981. These 44 plots were located within 37 study sites which were generally randomly located within the major habitat types of the area, although time and access problems made it necessary to

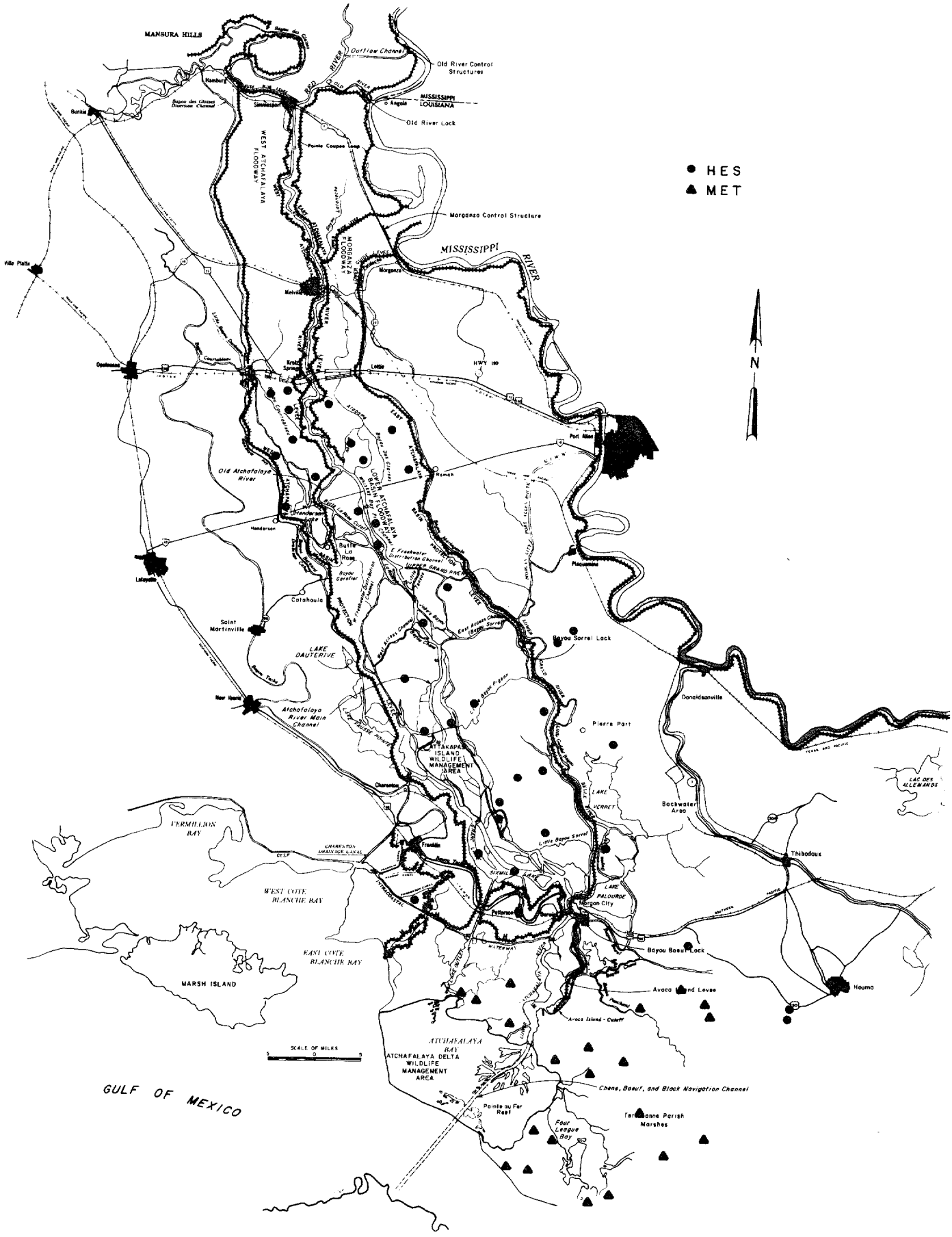


FIGURE G-2-1 HABITAT EVALUATION STUDY SITES

locate several sites adjacent to existing roads. Plot sizes were as prescribed in the standard HES methodology (US Army Corps of Engineers 1980). Results of the habitat evaluation analyses made on these plots are presented in Table G-2-1.

Marsh Evaluation Technique MET

G.2.6. Evaluation of 21 marsh plots located within the marsh areas south of Morgan City was carried out during the summer of 1980. These 21 plots were randomly located along major bayous and canals within fresh, brackish, and saline marsh types. Each plot consisted of a circular area with a radius of 1 kilometer. Within each plot, a habitat quality index was calculated in a manner similar to that used for determination of the HES habitat quality index. Five parameters were measured and used to calculate the habitat quality index. Each of these will be briefly described.

PLANT DIVERSITY

G.2.7. Plant diversity was measured by walking two randomly located 150 meter transects which were perpendicular to bayous or canals within each circular plot. A list of all plants seen along each transect was made and the total number of different species seen along both transects was determined. This number was then used in conjunction with a functional curve (Figure G-2-2) to calculate a curve score which is thought to be indicative of the value of the habitat for wildlife. The functional curve was drawn based upon the knowledge that wildlife value of marsh areas appears to be correlated with plant diversity. A survey of available literature and personal experience of a number of biologists was used as a basis for shaping the curve. Once the curve score was calculated, it was entered upon a data sheet (Figure G-2-3) and was later used in calculating a habitat quality index.

PERCENTAGE OF OPEN WATER

G.2.8. Percentage of open water making up the plot was determined using high-altitude color infrared photographs of the area made in 1978. Once the percentage figure was known, it was used in conjunction with a set of functional curves (Figure G-2-4) to determine a curve score which was entered upon the previously mentioned data sheet. Percentage of open water was assumed to be a good indicator of the amount of intertidal area or water-marsh "edge" within the plot;

TABLE G-2-1

HABITAT EVALUATION SYSTEM -
HABITAT QUALITY INDEX VALUES FOR TERRESTRIAL WILDLIFE

Habitat Type	Plot No.	HQI Value[1/4/]
LSBLHW[2/]	1	0.62
	2	0.56
	3	0.62
	4	0.51
	5	0.78
	6	0.44
	7	0.43
	8	0.60
	9	0.49
	10	0.63
	11	0.77
	12	0.58
	13	0.52
	14	0.43
	15	0.57
	16	0.64
	17	0.66
	18	0.50
ESBLHW[3/]	1	0.41
	2	0.44
	3	0.58
	4	0.32
	5	0.32
	6	0.46
	7	0.54
	8	0.39
Cypress-tupelo	1	0.71
	2	0.68
	3	0.71
	4	0.60
	5	0.73
	6	0.51
	7	0.55
	8	0.73
	9	0.75
	10	0.71
	11	0.71
	12	0.65
Open Land	1	0.33
	2	0.14
	3	0.42
	4	0.12
	5	0.15
	6	0.36

[1/] Habitat Quality Index - Possible values range from 0, which indicates habitat of no value, to 1, indicating habitat of maximum value.

[2/] Late successional bottomland hardwood forest.

[3/] Early successional bottomland hardwood forest.

[4/] Mean HQI and standard deviation for each habitat type are as follows: LSBLHW: 0.58 (0.10), ESBLHW: 0.43 (.09), Cypress-tupelo: 0.67 (0.77), and Open land: 0.26 (0.13).

FIGURE G-2-2
Marsh - Diversity of Emergent & Submergent Plant

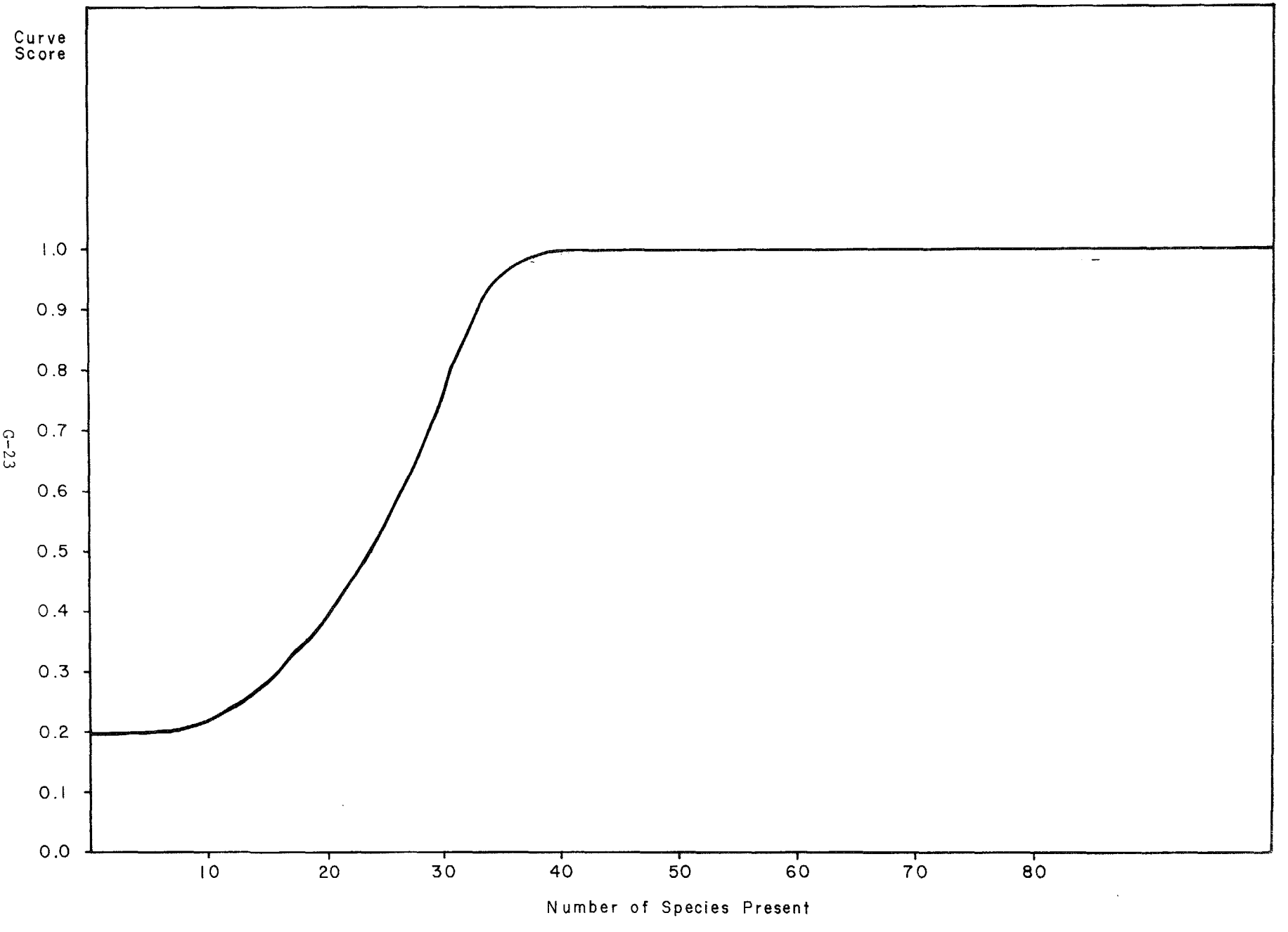


FIGURE G-2-3
MET EVALUATION

Site No.: Date:

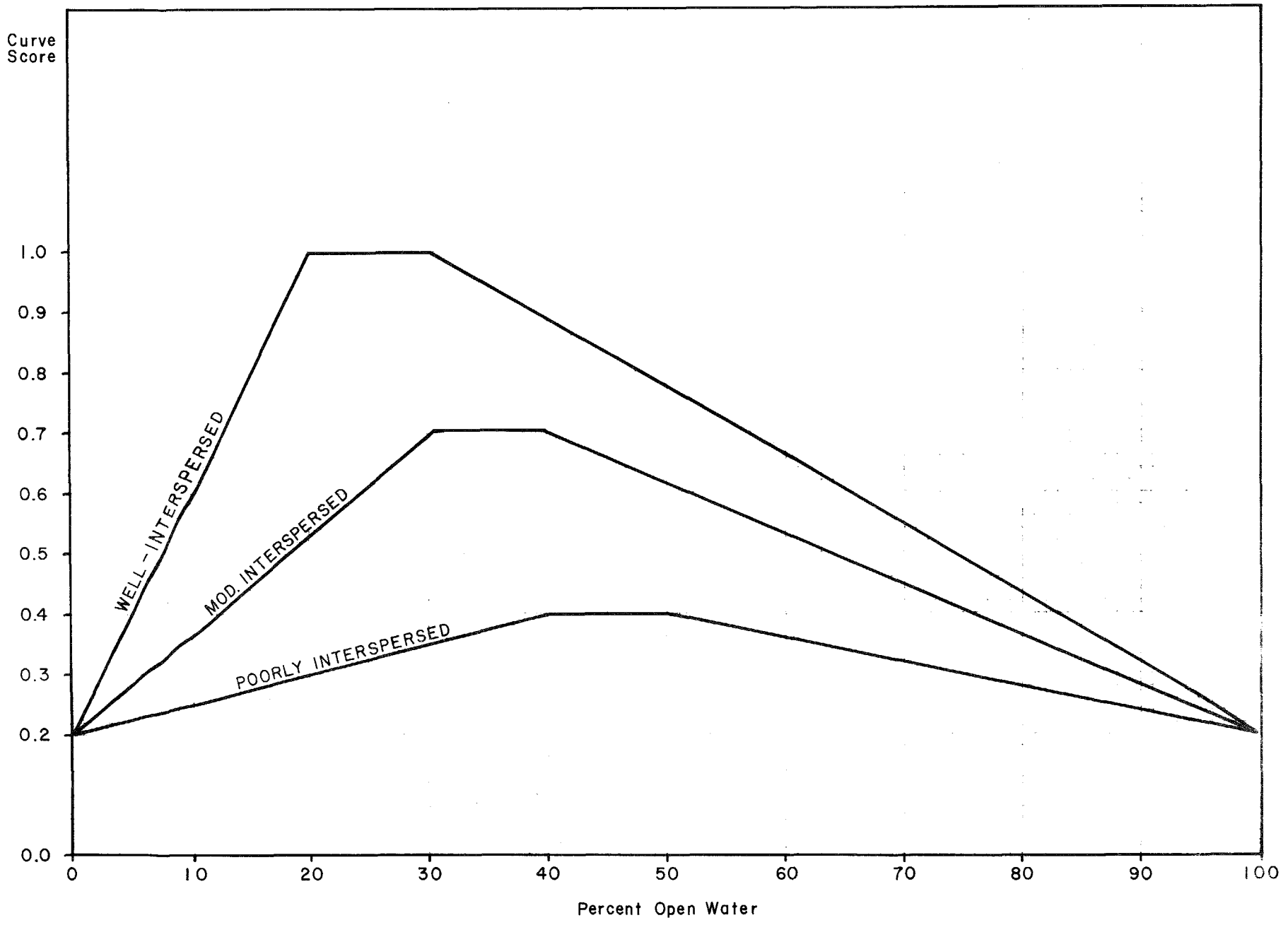
Location:

Habitat Type: Marsh HQI Score:

Parameter	Data	Curve Score	Curve Wt.	Weighted Score
1. Plant Diversity			0.30	
2. % Open Water			0.20	
3. % Non-flooded			0.20	
4. No. Ponds/3.14 km^2			0.10	
5. Naturalness Index			0.20	
		TOTAL		

NOTES

FIGURE G-2-4
Marsh - Percent Open Water



and accordingly, three functional curves were drawn to reflect how well the open water was interspersed with marsh vegetation. The three curves were drawn based primarily upon the personal experience of several biologists.

PERCENTAGE NON-FLOODED LAND

G.2.9. Percentage of land not flooded by a normal high tide was determined by using color infrared photos as described above, which were "ground truthed" at the same time the plant diversity transects were made. (Such lands are important for species such as rabbits and for shrub or tree nesting birds.) These percentage figures were used with a set of functional curves (Figure G-2-5) based upon the personal knowledge of several biologists to obtain curve scores which were then entered upon data sheets.

NUMBER OF PONDS

G.2.10. The number of ponds from 1 to 10 acres in size within each plot was calculated using the previously described color infrared photos. [Ponds of this size contain the greatest numbers of species of aquatic plants (Chabreck 1972) and are heavily utilized by waterfowl.] The number of ponds was used with a set of functional curves (Figure G-2-6) based upon the personal experience of several biologists, to calculate a curve score which was then entered upon a data sheet.

NATURALNESS INDEX

G.2.11. A naturalness curve score was calculated and entered upon a data sheet using the functional curve shown in Figure G-2-7. Naturalness was determined subjectively by use of color infrared photos as well as on-site inspection. Presence of man-made canals, levees or other structures, and presence or absence of pollutants were primary factors used in determining naturalness.

CALCULATION OF HABITAT QUALITY INDEX

G.2.12. A habitat quality index was calculated for each marsh plot using the five curve scores entered upon the data sheets (Figure G-2-3). Each parameter was assigned a weight. Weighted curve scores were then calculated and summed to obtain a habitat quality index for each plot. Results of these determinations are shown in Table G-2-2.

FIGURE G-2-5
Marsh - Percent Non Flooded Land

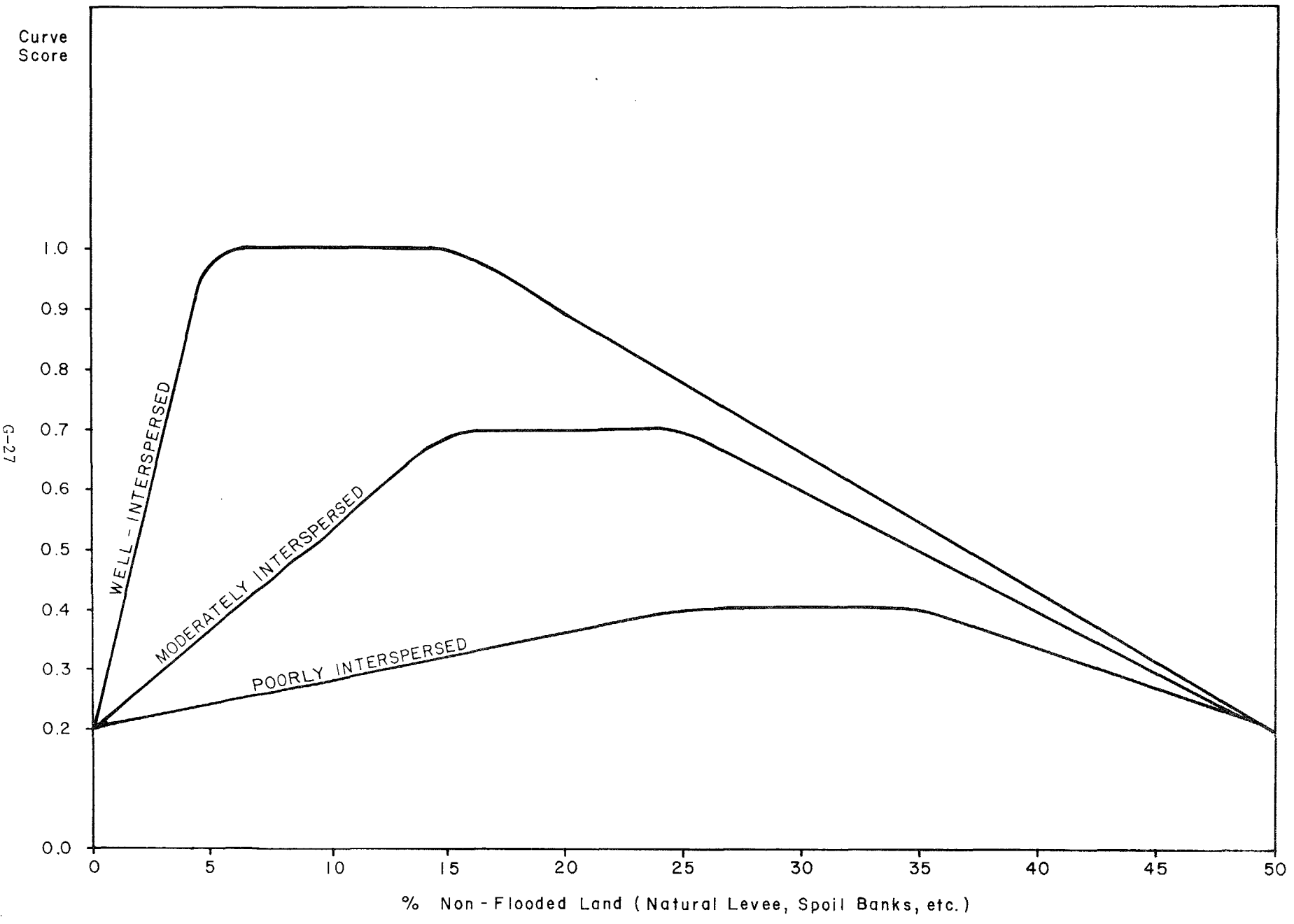


FIGURE G-2-6
Marsh - Number of Ponds 1-10 A in Size / 3.14 Km^2

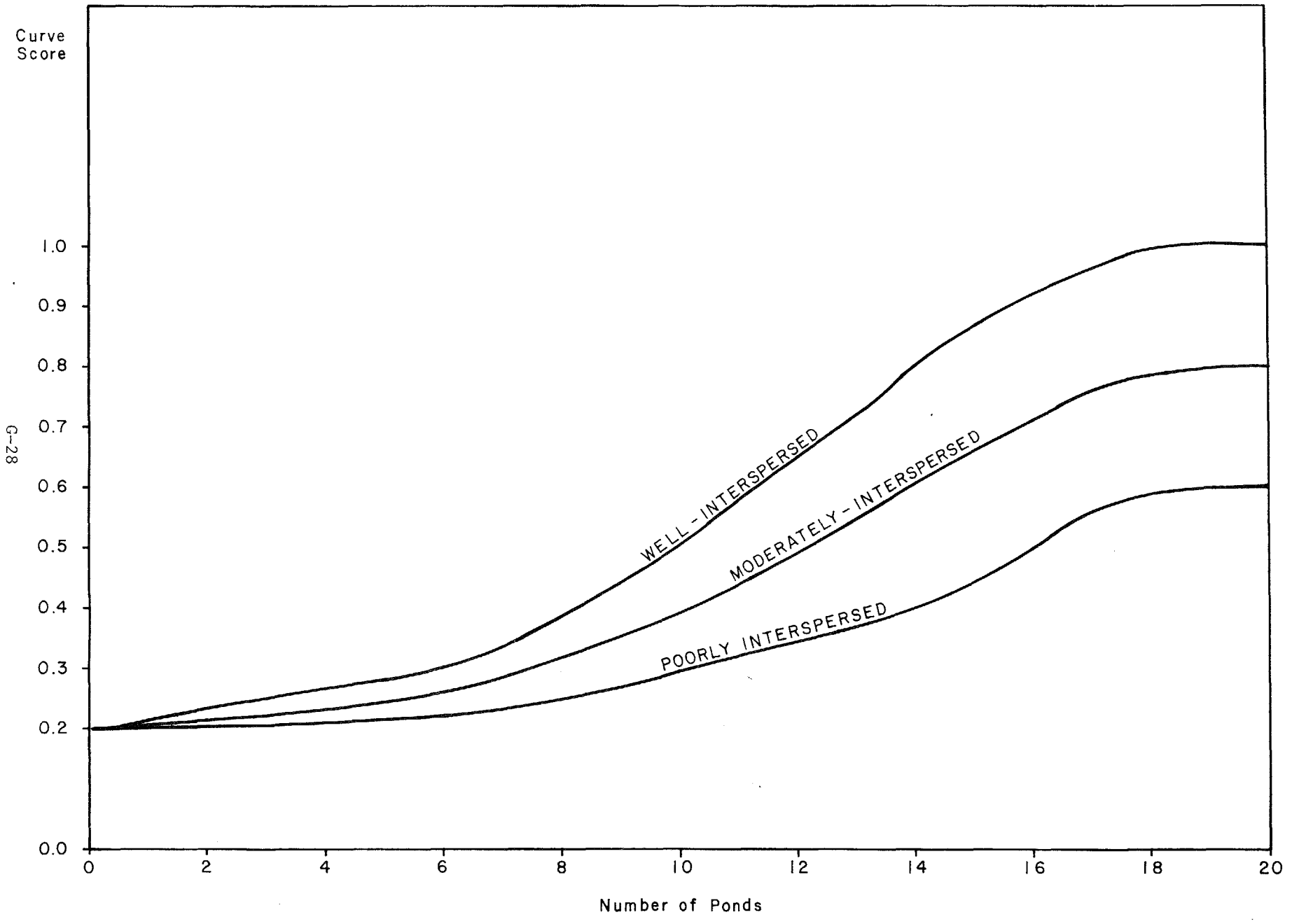


FIGURE G-2-7
Marsh - Naturalness Index

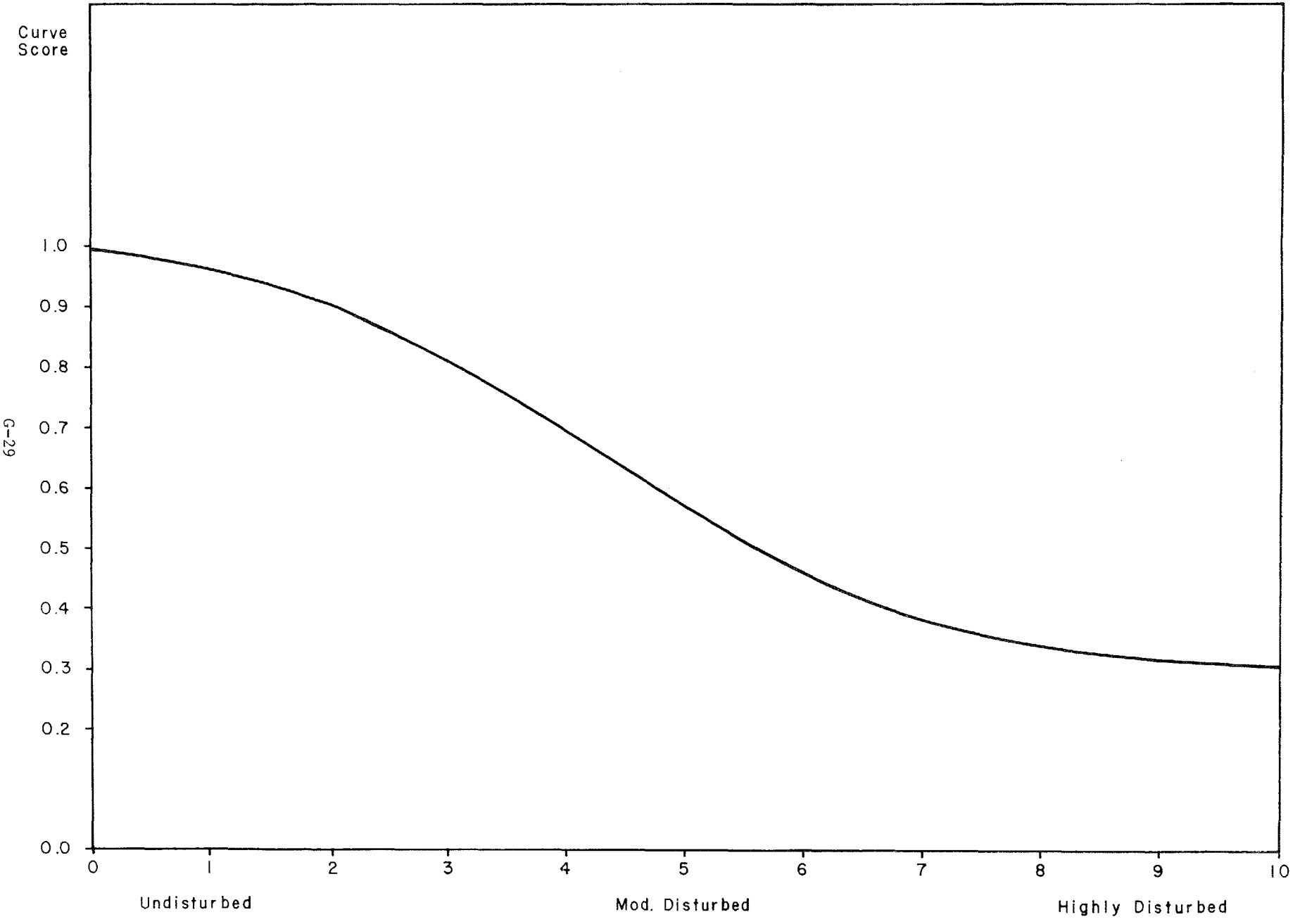


TABLE G-2-2

MARSH EVALUATION TECHNIQUE -
HABITAT QUALITY INDEX VALUES FOR TERRESTRIAL WILDLIFE

Habitat Type	Plot No.	HQI Value[1/2/]
Fresh Marsh	8	0.57
	5	0.61
	14	0.66
	17	0.78
	12	0.62
	1	0.76
	6	0.51
	5	0.48
	2	0.82
	9	0.76
	11	0.73
	4	0.70
Brackish Marsh	8	0.70
	9	0.84
	4	0.60
	6	0.58
	13	0.51
	15	0.70
	11	0.48
Saline Marsh	4	0.49
	3	0.58

1/ Habitat Quality Index - Possible values range from 0, which indicates habitat of no value, to 1, indicating habitat of maximum value.

2/ Mean HQI and standard deviations for each marsh type are as follows: Fresh marsh: 0.67 (0.10), Brackish marsh: 0.63 (0.13), Saline marsh: 0.54 (0.06).

Section 3 - TERRESTRIAL WILDLIFE HABITAT EVALUATION ANALYSIS

G.3.1. Habitat gains or losses in habitat units for the future without-project condition and the final three plans were calculated using the habitat evaluation field data previously described as a base. The existing habitat quality indices (HQI) for each habitat type were projected 50 years into the future. Tables G-3-1, G-3-2, and G-3-3 show the existing and projected values which were used in mitigation analyses and the rationale used in formulating them. Management potential and preservation credit for proposed bottomland hardwood fee purchase mitigation lands were calculated as follows.

Management Potential

G.3.2. It was assumed that the management potential for any bottomland hardwood fee lands obtained within the Lower Atchafalaya Basin floodway would be directly proportioned to the increase in HQI that would result from removal of cattle from the area. Existing HQI values for grazed and ungrazed lands near the Old River control structure were used as a basis for making the necessary calculations as outlined in the standard HES methodology (US Army Corps of Engineers 1980). Since management potential equals the annualized HQI of lands to be purchased with management minus the annualized HQI of proposed mitigation lands without management, this value was calculated as follows:

$$\frac{\text{Land with management}}{\frac{0.575^{1/} + 0.744^{2/}}{2}} \quad \text{minus} \quad \frac{\text{Land without management}}{\frac{0.575^{1/} + 0.604^{3/}}{2}} = 0.07$$

1/ 1980 HQI of grazed lands in floodway

2/ 1980 HQI of ungrazed lands at Old River (this was assumed to be the 2030 HQI of floodway lands)

3/ 1980 HQI of grazed lands at Old River (this was assumed to be the 2030 HQI of floodway lands)

TABLE G-3-1
ACTUAL AND PROJECTED HABITAT QUALITY INDICES
FOR THE FUTURE WITHOUT PROJECT CONDITION

Habitat Type	Year 1980	1990	2000	2010	2020	2030
Late Successional Bottomland Hardwood Forest	0.575	0.581	0.587	0.593	0.599	0.605[1/]
Early Successional Bottomland Hardwood and Composition Unknown Forest	0.432	0.446	0.460	0.474	0.488	0.504[2/]
Cypress-Tupelo and Bottomland Hardwood/Cypress-Tupelo Mixed Forest	0.670	0.670	0.670	0.670	0.670	0.670[3/]
Open Land	0.256	0.245	0.234	0.223	0.212	0.200[4/]
Fresh Marsh and Delta	0.668	0.655	0.642	0.629	0.616	0.601[5/]
Brackish Marsh	0.630	0.617	0.604	0.591	0.578	0.567[5/]
Saline Marsh	0.535	0.524	0.513	0.502	0.491	0.481[5/]

1/ 0.605 equals the present Habitat Quality Index (HQI) of grazed late successional bottomland hardwood forest at Old River.

2/ 0.504 equals the mid-point between 1980 HQI values for early and late successional bottomland hardwood forest.

3/ Assumed to stay the same due to the cancelling effect of logging timber and increased groundcover following logging.

4/ Estimated using intuition. Decrease is due to assumed clearing of adjacent forests.

5/ Assumed a 10 percent reduction in HQI values over a 50 year period due to land loss, canal building, etc. Sufficient data do not exist to define this matter more precisely.

TABLE G-3-2
ACTUAL AND PROJECTED HABITAT QUALITY INDICES
FOR PLANS 4 AND 9

Habitat Type	Year 1980	1990	2000	2010	2020	2030
Late Successional Bottomland Hardwood Forest	0.575	0.581	0.587	0.593	0.599	0.605[1/]
Early Successional Bottomland Hardwood and Composition Unknown Forest	0.432	0.446	0.460	0.479	0.488	0.504[2/]
Cypress-Tupelo and Bottomland Hardwood/Cypress-Tupelo Mixed Forest	0.670	0.670	0.670	0.670	0.670	0.670[3/]
Open Land	0.256	0.256	0.256	0.256	0.256	0.256[4/]
Fresh Marsh and Delta	0.668	0.655	0.642	0.629	0.616	0.601[5/]
Brackish Marsh	0.630	0.617	0.604	0.591	0.578	0.567[5/]
Saline Marsh	0.535	0.524	0.513	0.502	0.491	0.481[5/]

[1/] 0.605 equals the present Habitat Quality Index (HQI) of grazed late successional bottomland hardwood forest at Old River.

[2/] 0.504 equals the mid-point between 1980 HQI values for early and late successional bottomland hardwood forest.

[3/] Assumed to stay the same due to the cancelling effect of logging timber and increased groundcover following logging.

[4/] No change in HQI would occur due to environmental easements.

[5/] Assumed a 10 percent reduction in HQI values over a 50 year period due to land loss canal building, etc. Sufficient data do not exist to define this matter more precisely.

TABLE G-3-3
ACTUAL AND PROJECTED HABITAT QUALITY INDICES
FOR PLAN 7

Habitat Type	Year 1980	1990	2000	2010	2020	2030
Late Successional Bottomland Hardwood Forest	0.575	0.581	0.587	0.593	0.599	0.605[1/]
Early Successional Bottomland Hardwood and Composition Unknown Forest	0.432	0.446	0.460	0.474	0.488	0.504[2/]
Cypress-Tupelo and Bottomland Hardwood/Cypress-Tupelo Mixed Forest	0.670	0.670	0.670	0.670	0.670	0.670[3/]
Open Land	0.256	0.245	0.234	0.223	0.212	0.200[4/]
Fresh Marsh and Delta	0.668	0.641	0.614	0.587	0.560	0.534[5/]
Brackish Marsh	0.630	0.605	0.580	0.555	0.530	0.504[5/]
Saline Marsh	0.535	0.514	0.493	0.472	0.451	0.428[5/]

[1/] 0.605 equals the present Habitat Quality Index (HQI) of grazed late successional bottomland hardwood forest at Old River.

[2/] 0.504 equals the mid-point between 1980 HQI values for early and late successional bottomland hardwood forest.

[3/] Assumed to stay the same due to the cancelling effect of logging timber and increased groundcover following logging.

[4/] Estimated using intuition. Decrease is due to assumed clearing of adjacent forests.

[5/] Assumed a 20 percent reduction in HQI values over a 50 year period due to accelerated land loss following reduction of river overflow and influence. Sufficient data do not exist to define this matter more precisely.

Preservation Credit

G.3.3. Preservation credit for bottomland hardwood fee lands was calculated in a manner similar to that of management potential by subtracting the annualized HQI of lands without purchase from the annualized HQI of lands with purchase. In this case, it was assumed that 80 percent of the potential purchase area would become agricultural land in the future and that the relative value indices for bottomland hardwoods and open land were 0.9 and 0.1, respectively. Preservation credit was figured as follows:

With Purchase

$$\frac{0.575^{1/}\ (1.0) + 0.745^{2/}\ (1.0)}{2}$$

minus Without Purchase

$$\frac{0.575^{1/}(1.0) + [0.604^{3/}(0.2)^{4/}(0.9)^{5/} + 0.20^{6/}(0.8)^{7/}(0.1)^{8/}]}{2} = 0.31$$

1/ 1980 HQI grazed land in floodway

2/ 1980 HQI ungrazed land at Old River

3/ 1980 HQI grazed land at Old River

4/ Amount of initial land remaining in forest in 2030

5/ Relative value index for bottomland hardwood

6/ 2030 HQI for open land

7/ Amount of initial land in open land category in 2030

8/ Relative Value Index for open land

Habitat Evaluation Analyses

G.3.4. Gains or losses of habitat units for the future without-project condition and the three final plans are shown by major land use categories in Table G-3-4.

TABLE G-3-4

ANNUALIZED GAINS OR LOSSES OF HABITAT UNITS (1,000's)

Land Use Category	Future Without Project Condition	Plan 4	Plan 7	Plan 9
Bottomland Forest[1/] Open Land	-4.45	+41.0	-6.40	+41.0
Swamp[2/]	-1.55	+2.7	-11.1	+20.7
Marsh[3/]	0.00	-0.2	-3.0[4/]	-0.2

[1/] Includes early and late successional bottomland hardwood forest open land, and composition unknown forest.

[2/] Includes cypress-tupelo swamp and cypress-tupelo mixed with bottomland hardwoods.

[3/] Includes fresh, brackish, and saline marsh and delta.

[4/] Minus 19.2 if the entire Avoca Island levee were built.

Section 4 - MITIGATION NEEDS

G.4.1. Mitigation needs were calculated using the data generated in the habitat evaluation analyses. This data was processed using the US Army Corps of Engineers LMVD-HES computer program. These needs will be discussed for the future without-project condition and for each of the three final plans.

Future Without - Project Condition

G.4.2. Losses induced by the continued raising of the floodway protection levees would include 3,016 annualized habitat units (AHU) of flooded forest, 1,550 AHU's of swamp, and 4,450 AHU's of bottomland forest - open land (bottomland forest and open land were combined as open land is generally produced by clearing bottomland forests). The best method to mitigate for losses of flooded forest and swamp would be to re-open the Wax Lake overbank area to river overflow flooding. To do this, it would be necessary to build a levee from the Wax Lake Outlet to the Bayou Sale ridge. This levee would lie south of and parallel to the Southern Pacific railroad tracks. The existing levee along the western bank of Wax Lake Outlet and the northern bank of the Gulf Intracoastal Waterway would then be degraded to ground level and the existing bayou would be re-connected to Wax Lake Outlet. Mitigation for the loss of 3,016 AHU's of flooded forest would be accomplished by this action since the 7,800 acres of swamp in the overbank area are probably flooded approximately 2 months at the present time and thus have a HQI of approximately 0.2. By opening the area to river and tidal influence, the entire area would assume the HQI for flooded cypress-tupelo which is 0.55. Accordingly, the management potential would be 0.35 (0.55 - 0.2). The acres necessary for mitigation are calculated as follows:

$$\text{Acres} = \frac{\text{AHU lost}}{\text{management potential}} = \frac{3016}{.35} = 8617$$

Thus 7,800 acres would replace most of the necessary AHU's.

G.4.3. Mitigation for loss of 1,550 AHU's of swamp would be accomplished if it is assumed that re-connecting this area to river overflow has a management potential of 0.2 (due to time and personnel constraints, it was not possible to determine actual management potential). Mitigation for loss of 4,450 AHU's of bottomland forest - open land habitat would be accomplished by the purchase and management of 12,000 acres of bottomland hardwood forest within the floodway (calculated using a management potential of 0.07 and a preservation credit of 0.31 as discussed previously in the section on habitat evaluation analysis).

G.4.4 Costs for the mitigation measures outlined above would be as shown on Table G-4-1.

TABLE G-4-1

COSTS OF MITIGATION MEASURES FOR THE FUTURE WITHOUT-PROJECT CONDITION

Action	Total First Costs	Annual I&A[1/]	Annual O&M[2/]	Total Annual Costs
Re-open Wax Lake Overbank Area	$40,000,000[3/]	$3,052,000	none	$3,052,000
Purchase 12,000 Acres of Bottomland Hardwood Forest	9,403,000[4/]	717,000	18,000[5/]	735,000
Totals	$49,403,000	$3,769,000	$18,000	$3,787,000

[1/] Interest and Amortization - 7 5/8 percent for 100 years.

[2/] Operation and Maintenance.

[3/] Approximately one-half the cost of widening Wax Lake Overbank as proposed in the recommended plan. This mitigation proposal would not have the major relocation costs associated with widening the entire overbank area.

[4/] Based upon a unit land cost of $580 per acre, contingency costs of 25 percent, acquisition costs of $4,000 per tract for 82 traces, development costs of $30 per acre, and total resettlement cost of $75,000.

[5/] Assumed to be $1.50 per acre.

Plan 7 (NED)

G.4.5. Losses induced by this plan would be about 8,500 AHU's of flooded forest habitat, 6,400 AHU's of bottomland forest - open land habitat, 11,100 AHU's of swamp habitat and 3,000 AHU's of marsh habitat (19,200 if the entire Avoca Island levee were built).

G.4.6. The best method to mitigate for the loss of flooded forest habitat and about a third of the swamp habitat would be to build the Buffalo Cove management unit. (This assumes that building the unit would actually benefit aquatic resources). This action would maintain the present water levels and thus prevent clearing. At the present time, 23,910 acres of early successional bottomland hardwoods and 11,730 acres of cypress-tupelo are flooded yearly in Buffalo Cove. In the future with Plan 7, only 5,100 acres of early successional and 6,120 acres of cypress-tupelo forest would be flooded. Therefore, construction of the management unit would preserve flooding on 18,797 acres of early successional forest with an HQI of 0.27 for a total of 5,075 AHU's preserved. Flooding would also be retained on 5,610 acres of cypress-tupelo forest with an HQI of 0.55 for flooded forest, for a total of 3,085 AHU's of flooded forest preserved. This flooding would also preserve about 4,000 AHU's of swamp habitat if one assumes a preservation credit of 1.0 for swampland saved by building the management unit. Thus, construction of the management unit would preserve a total of about 8,200 AHU's of flooded forest habitat and 4,000 AHU's of swamp habitat which would mostly mitigate for the overall 8,500 AHU's loss of flooded forest habitat. To mitigate for the remaining 7,100 AHU's of swamp habitat it might be possible to build a water diversion structure which would direct sufficient Mississippi River water into existing swampland south of the river downstream from Donaldsonville, Louisiana, so that the habitat quality index of the swamps would be raised in a manner similar to that described for the future without project mitigation plan. A structure similar to the one described below for marsh habitat mitigation would probably suffice.

G.4.7. To mitigate for loss of 6,400 AHU's of bottomland forest - open land habitat it would be necessary to purchase and manage, as described for the future without-project condition, 16,800 acres of bottomland hardwood habitat.

G.4.8. To mitigate for loss of 3,000 AHU's of marshland, it is proposed that management of marsh through freshwater introduction be carried out by diverting water from the Mississippi River into suitable areas adjacent to the river.

G.4.9. It is not possible at this time to estimate precisely how much land would have to be managed, nor is it possible to estimate how

much productivity could be increased through freshwater introduction. To replace the entire project-induced loss due to building the first extension of the Avoca Island levee could require the management of 15,000 acres (assuming a management potential of 0.2). A recent report (Gagliano 1981) on marsh deterioration in Louisiana stated that water diversion structures could be built which would benefit an area of up to 30,000 acres in extent. One structure of this type would probably be adequate to meet the mitigation needs of plan 7.

G.4.10. If the entire Avoca Island levee were built, additional mitigation would be necessary. To replace the remainder of the project-induced loss which could result from implementation of plan 7 (16,200 AHU's) could require the management of over 100,000 acres (assuming a management potential of 0.2). Four structures of this type mentioned previously would probably be adequate to meet the mitigation needs of plan 7. Estimated cost for implementing mitigation measures for this plan are shown in Table G-4-2.

Plans 4 (EQ) and 9 (Recommended)

G.4.11. Mitigation needs for plans 4 and 9 would arise due to the estimated loss of 200 annualized habitat units of marsh habitat. Since implementation of both of these plans would result in a net gain of over 40,000 AHU's of bottomland hardwood-open land habitat and almost 3,000 AHU's of swamp habitat, it was assumed that these gains would offset the small lost of marsh habitat.

TABLE G-4-2

SUMMARY OF ESTIMATED MITIGATION COSTS FOR PLAN 7 (NED)

Action	Total First Costs	Annual I&A[1/]	Annual O&M[2/]	Total Annual Costs
Purchase of 16,800 acres of Bottomland Hardwood Forest	$13,144,000[3/]	$1,003,000	$25,000[4/]	$1,028,000
Freshwater Diversion (Swamp)	15,000,000	1,145,000	-	1,145,000
Freshwater Diversion (Marsh)	15,000,000[5/] (1,000,000,000)[6/]	1,145,000[5/] (7,630,000)[6/]	- -	1,145,000[5/] (7,630,000)[6/]
Implement Buffalo Cove Management Unit	3,700,000[7/]	282,000	10,000	292,000
TOTAL	$46,844,000[5/] ($131,844,000)[6/]	$3,575,000[5/] ($10,060,000)[6/]	35,000 35,000	$3,610,000[5/] ($10,095,000)[6/]

[1/] Interest and Amortization - 7 5/8 percent for 100 years.

[2/] Operation and Maintenance.

[3/] Based on a unit land cost of $580 per acre, contingency costs of 25 percent, acquisition costs of $4,000 per tract for 110 tracts, development costs of $30 per acre, and total resettlement cost of $20,000.

[4/] Assumed to be $1.50 per acre.

[5/] Cost with first levee extension only.

[6/] Cost with entire levee extension.

[7/] Derived from data used in cost estimate preparation for plan 4.

Section 5 - METHODOLOGY FOR ATCHAFALAYA BASIN FLOODWAY LAND USE - HABITAT TYPE PROJECTIONS

G.5.1. Vegetation associations and habitat types (both land and water) within the Atchafalaya Basin form a complex and continually changing pattern. The changing nature of this pattern is due primarily to plant successional changes induced by changing water levels and hydroperiods coupled with sediment deposition in open water and overbank areas. These naturally occurring changes have created a number of distinct vegetation associations and habitat types which have been further altered by human activities such as land clearing for agricultural purposes or canal dredging for mineral extraction. These habitat types are discussed in detail in Appendix A.

Methodology for Projecting Habitat Changes

G.5.2. In order to predict and project future habitat conditions for the various project alternatives, it was necessary to evaluate the effects of changing water levels and hydroperiods, sedimentation, land clearing for agriculture, and the ongoing ecological process of natural succession on the existing habitat types. To do this, a team composed of biologists from the US Fish and Wildlife Service and the US Army Corps of Engineers was formed. This team utilized its personal knowledge of the functioning of the project area ecosystems, augmented by information received from a Corps economist and a number of professional foresters and ecologists, in formulating a methodology for projecting the habitat changes which might be expected to occur with the various alternative plans evaluated. The methodology decided upon is described as follows:

LAND CLEARING PROJECTIONS

G.5.3. Land clearing projections were made for all plans by using hydrologic and sedimentation data supplied by the Corps and by using the following assumptions as a basis for calculating projected acreages to be cleared.

G.5.4. All lands flood free 3 out of 5 years from 1 June through 30 November were assumed to be suitable for agricultural use (except certain floodway lands south of river mile 80 which are mostly state-owned or which occur in such small tracts as to be infeasible to farm).

G.5.5. Land clearing was assumed to proceed from north to south as it has historically, and the floodway proper was divided into three zones to reflect this. These zones are as follows:

- o Zone a. Henderson and Alabama Bayou - Land clearing to begin in 1980.
- o Zone b. Bayou des Glaises, Warner Lake, Cocodrie Swamp, Beau Bayou, Pigeon Bay, Buffalo Cove, and Flat Lake - Land clearing to begin in 1995.
- o Zone c. Upper Belle River, Crevasse, and Sixmile Lake - No clearing to occur during project life.

G.5.6. Not all lands suitable for agricultural use would be cleared due to factors such as limited access or tract size. It was assumed that 80 percent of the suitable land in zones a and b and in the backwater area northeast of Morgan City could ultimately be cleared.

G.5.7. It was assumed that land clearing would start slowly, accelerate and then taper off as has been the case historically. The following percentage factors were applied to the acres suitable for clearing to calculate the acres that would probably be cleared.

	Percent Cleared		
Year	Zone a	Zone b	Zone c
1980	0	0	0
1990	15	0	0
2000	60	15	0
2010	76	60	0
2020	78	76	0
2030	80	78	0

These same clearing trends were used in calculations for the backwater area northeast of Morgan City, but since much of this area has already been cleared, it was necessary to fit the existing cleared acres into the cumulative land clearing curve from which the above percent cleared figures were derived. After doing this, the amount of land which remained to be cleared could be calculated (see Appendix D for this curve).

TERRESTRIAL VEGETATIVE SUCCESSION PROJECTIONS

G.5.8. Vegetative succession projections were made utilizing Corps hydrologic and sedimentation data and the following assumptions.

o It was assumed that future sediment deposition in the floodway would not adversely affect bottomland hardwood habitat types nor cause them to succeed to a different type.

o Due to the stand age of the early successional bottomland hardwood areas in the Henderson unit, it was assumed that these areas would become mid-successional bottomland hardwood areas by 1990.

o It was assumed, following field investigations, that cypress-tupelo areas would succeed to a cypress-tupelo/bottomland hardwood mix when lowering of water levels and shortening of hydroperiods caused these areas to be flood free 3 out of 5 years during the 1 June through 30 November time period. (Some mixing was also recognized in areas wetter than this, but this could not be quantified.) This mixed forest type was assumed to be a mix of cypress-tupelo with willow or cottonwood and sycamore, in areas receiving significant sediment impact and a mix of cypress-tupelo with ash and maple in areas not receiving significant sediment impact.

o In some areas, it was not possible to predict what type of succession would occur (due to lack of data on stand ages or lack of hydrologic data) and in such areas it was assumed that the forest would convert to a forested unknown category.

AQUATIC HABITAT SUCCESSIONAL PROJECTIONS

G.5.9. Aquatic habitat successional projections were made using Corps hydrologic and sedimentation data. These projections consisted basically of calculating the number of acres of existing water bodies that would be eliminated by sedimentation and assigning the vegetative community that would grow on the newly formed accretion lands to the forested unknown terrestrial category (as requested by the US Environmental Protection Agency).

Section 6 - PREPARATION OF DESIRED HYDROGRAPHS

G.6.1. In November of 1979, representatives of the US Army Corps of Engineers (Corps), US Fish and Wildlife Service (US FWS), and US Environmental Protection Agency (EPA) met to propose theoretical desired hydrographs for each of the management unit areas which reflected what each agency then felt would be a desirable condition to attempt to achieve in order to preserve the biological resources of the lower Atchafalaya Basin floodway. The rationale used in preparing these hydrographs is discussed in the following paragraphs as well as subsequent modification of three of the hydrographs at the insistence of the EPA. Also discussed, are subsequent reservations held by the Corps regarding the desirability of attempting to implement the theoretical hydrographs. These reservations developed since the original November 1979 meetings.

G.6.2. The rationale used in preparing the desired hydrographs was as follows. The hydrographs were drawn so as to mimic, somewhat, the actual 1965 hydrograph, which was considered at that time to be a typical or average year. The peak was established at 15 April, which is the average river peak date. Low points on the hydrographs were established by using either bankfull elevations (estimated and surveyed at various points in the basin in the winter of 1978) or, where no such surveys were done, swamp floor elevations (from Corps survey range line data). A critical date for falling water levels was considered to be 15 June, by which time it was assumed that water should no longer flood dry bottomland hardwood tree species. Hydrographs were drawn so that this forest type would not be flooded past the 15 June date. Data from Corps land-use maps, Corps topographic maps and maps from the US Geological Survey report entitled "Trend Analysis of Vegetation in Louisiana's Atchafalaya River Basin" (O'Neil et al. 1975) were used in determining the needed 15 June flood-free elevations.

G.6.3. The results of this work are shown in Figures G-6-1 through G-6-11 which show the theoretical desired hydrographs prepared during the November 1979 meetings.

G.6.4. At a meeting on 27 August 1980, between the Corps, US FWS, and EPA, it was proposed by EPA that the November 1979 desired hydrographs for Flat Lake, Bayou des Glaises, and Upper Belle River be revised to reflect what EPA considered to be a more accurate reflection

FIGURE G-6-1 THEORITICAL DESIRED HYDROGRAPH FOR HENDERSON

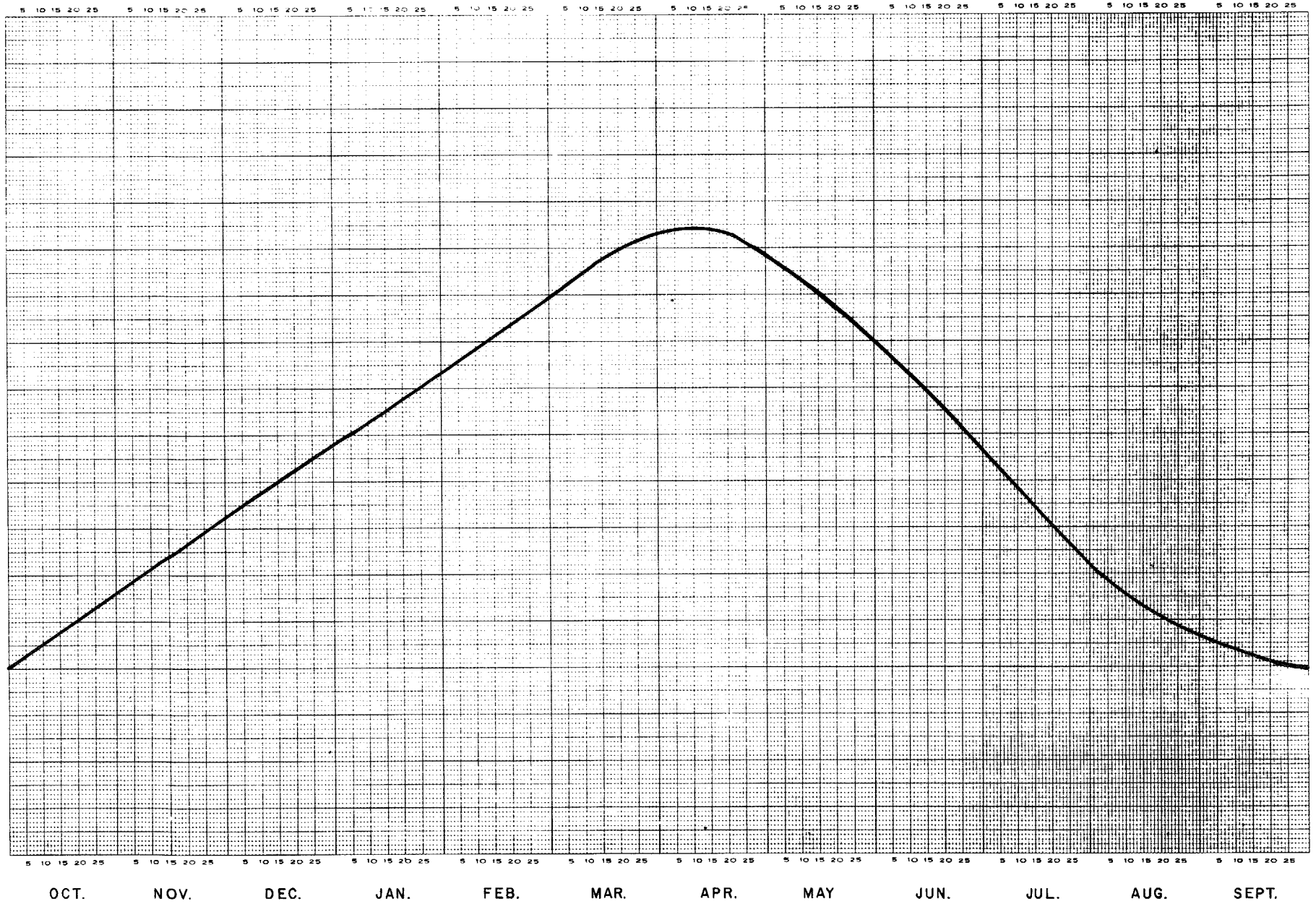


FIGURE G-6-2 THEORETICAL DESIRED HYDROGRAPH FOR ALABAMA BAYOU

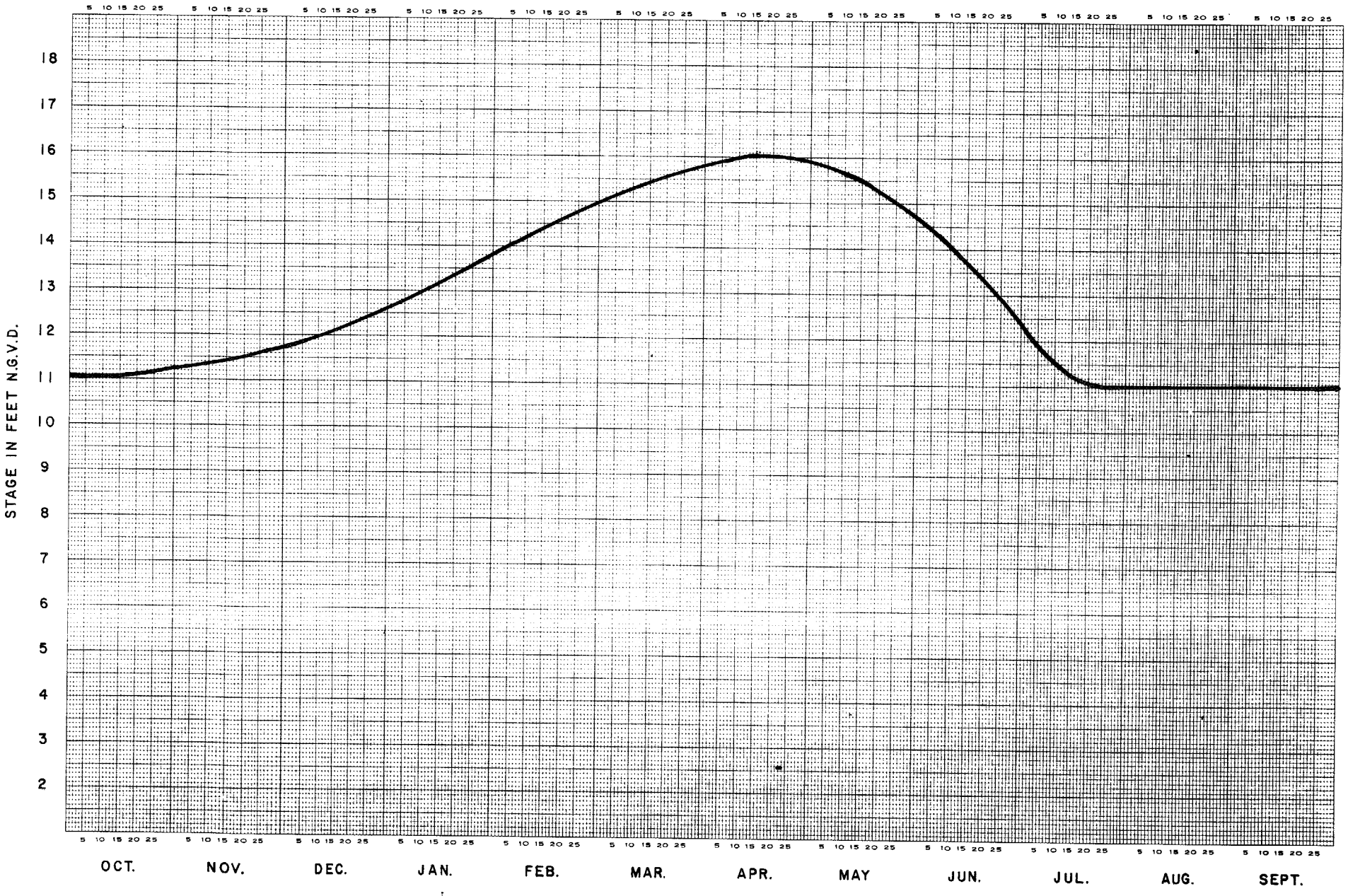


FIGURE G-6-3 THEORETICAL DESIRED HYDROGRAPH FOR WARNER LAKE

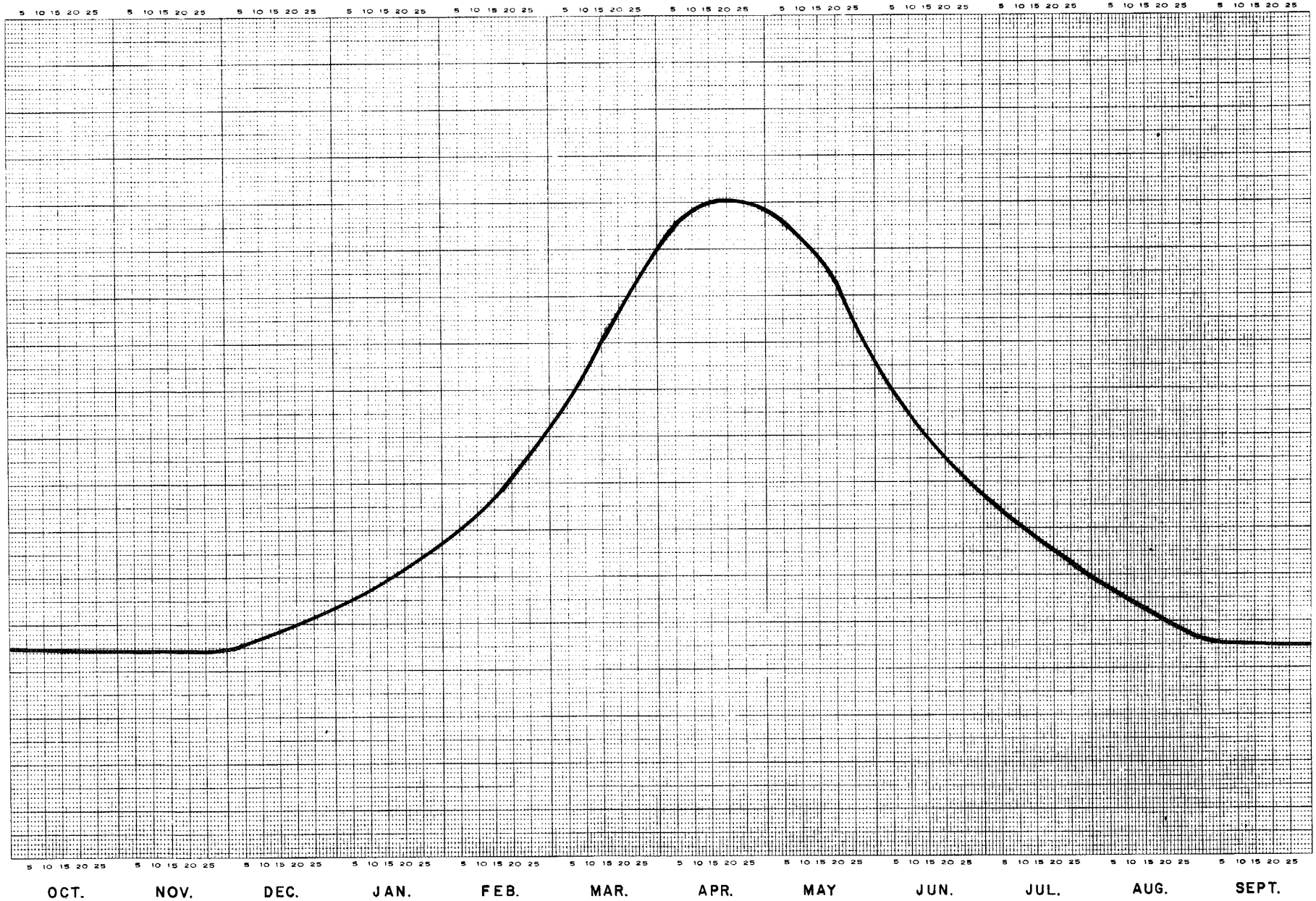


FIGURE G-6-4 THEORETICAL DESIRED HYDROGRAPH FOR COCODRIE SWAMP

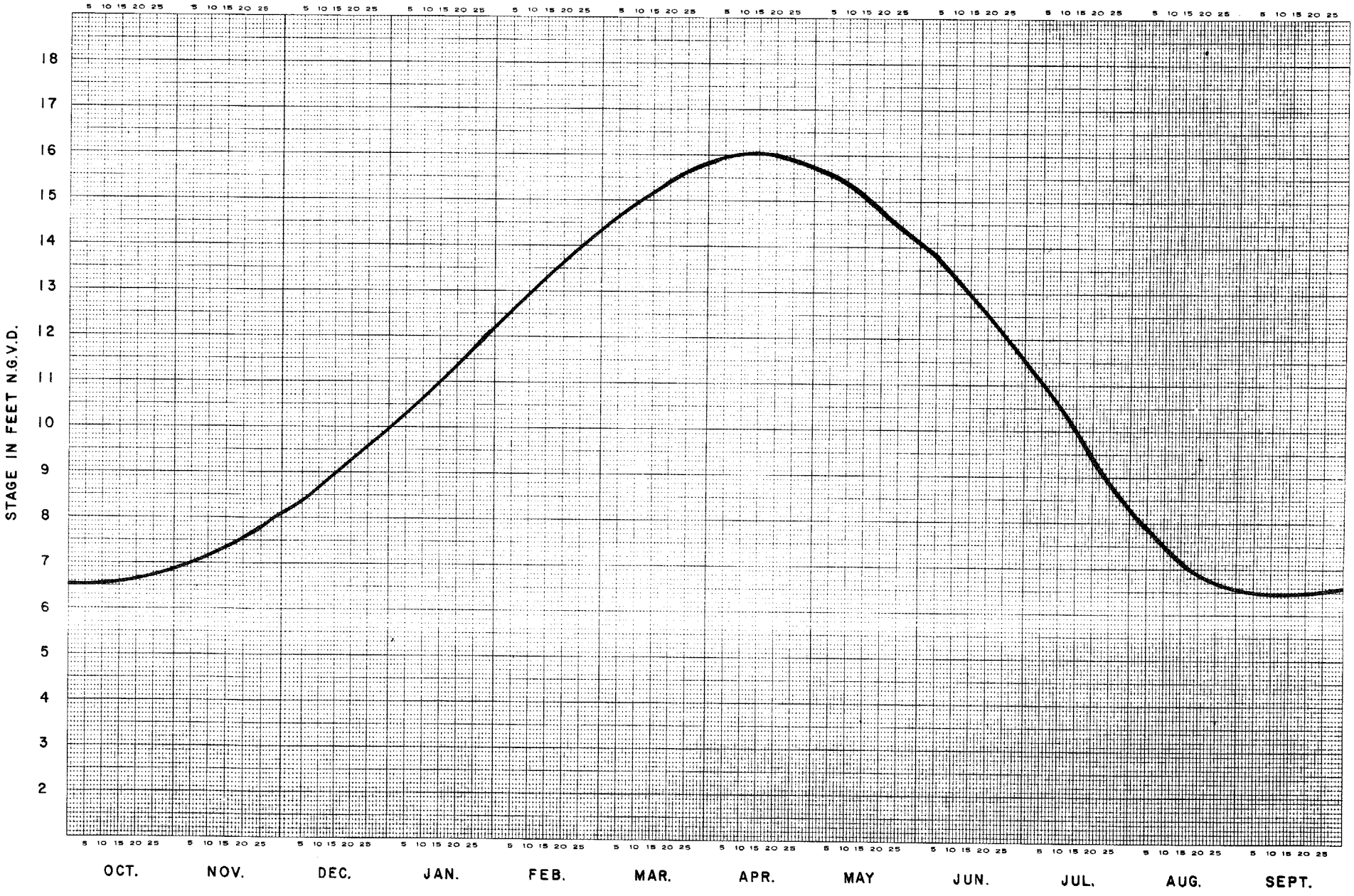


FIGURE G-6-5 THEORETICAL DESIRED HYDROGRAPH FOR BAYOU DES GLAISES

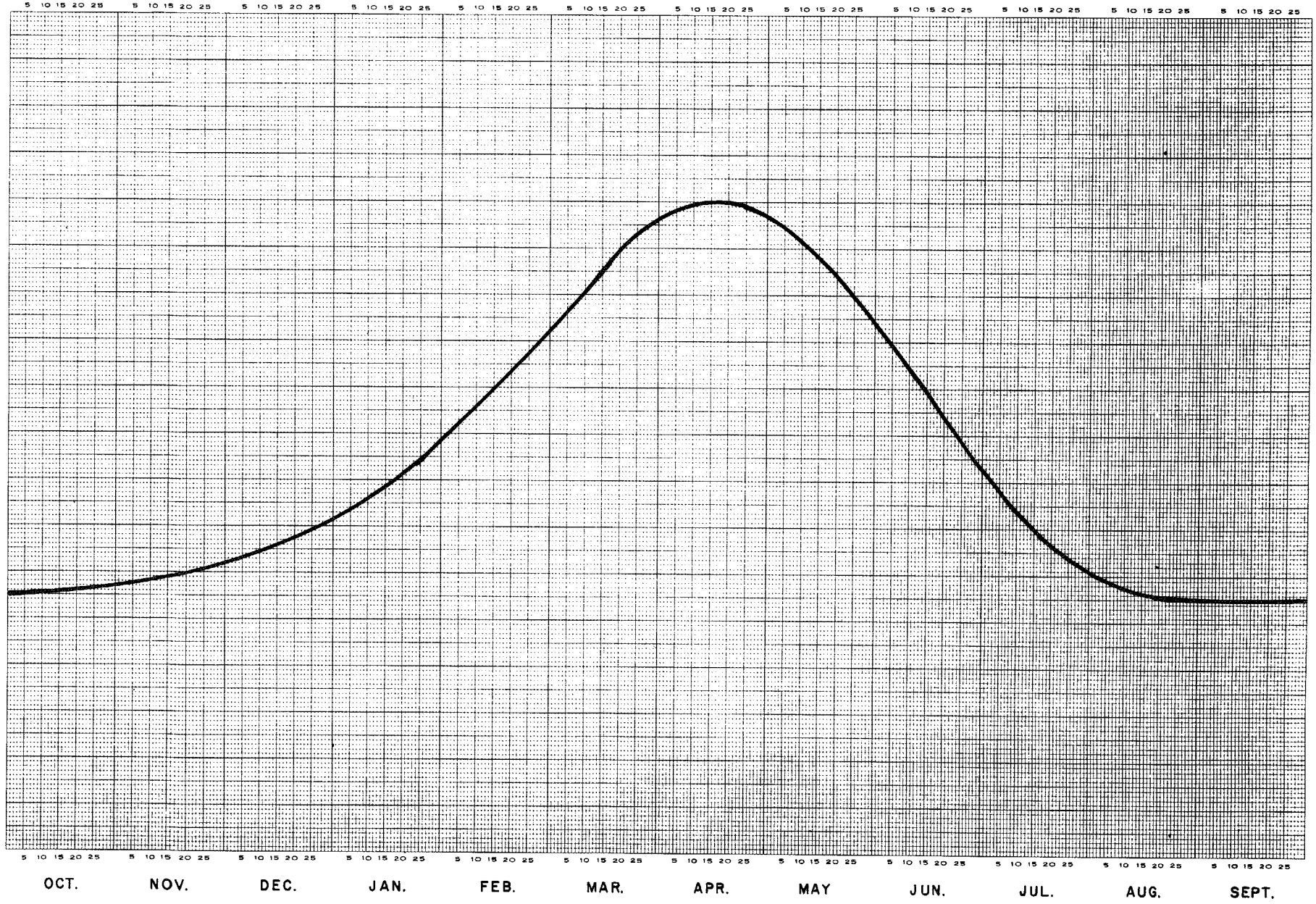


FIGURE G-6-6 THEORETICAL DESIRED HYDROGRAPH FOR BEAU BAYOU

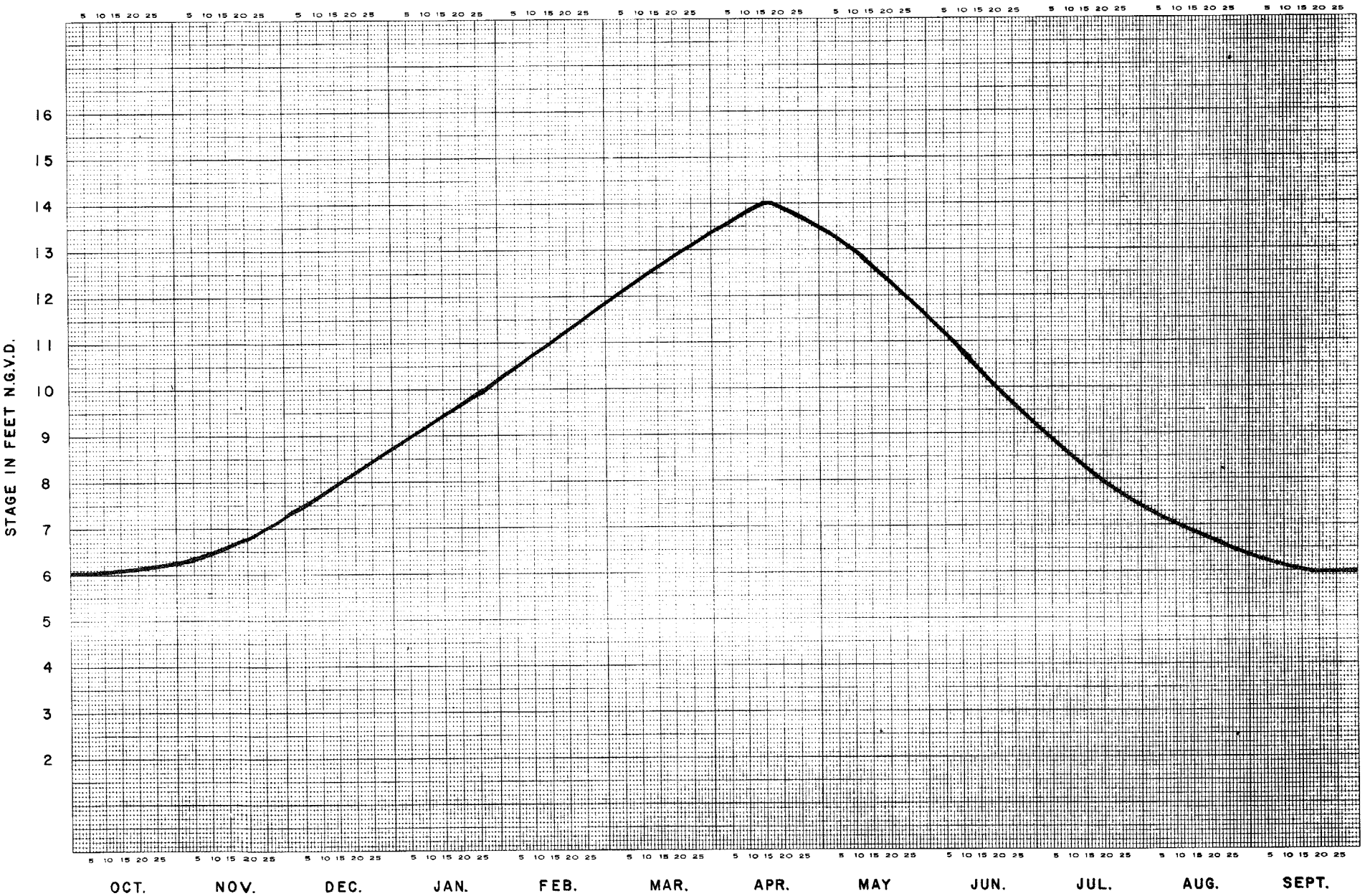


FIGURE G-6-7 THEORETICAL DESIRED HYDROGRAPH FOR PIGEON BAY

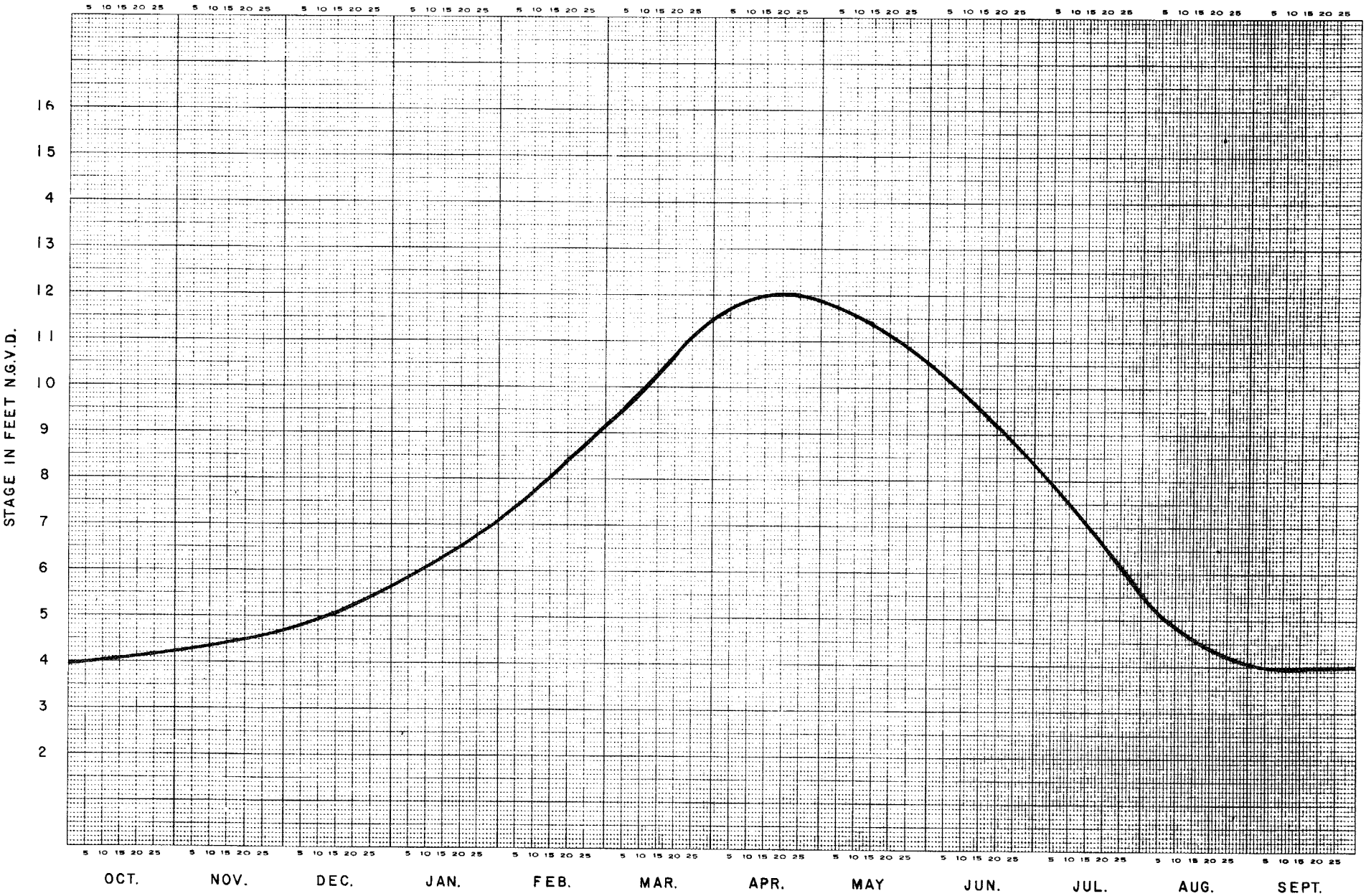


FIGURE G-6-8 THEORETICAL DESIRED HYDROGRAPH FOR BUFFALO COVE

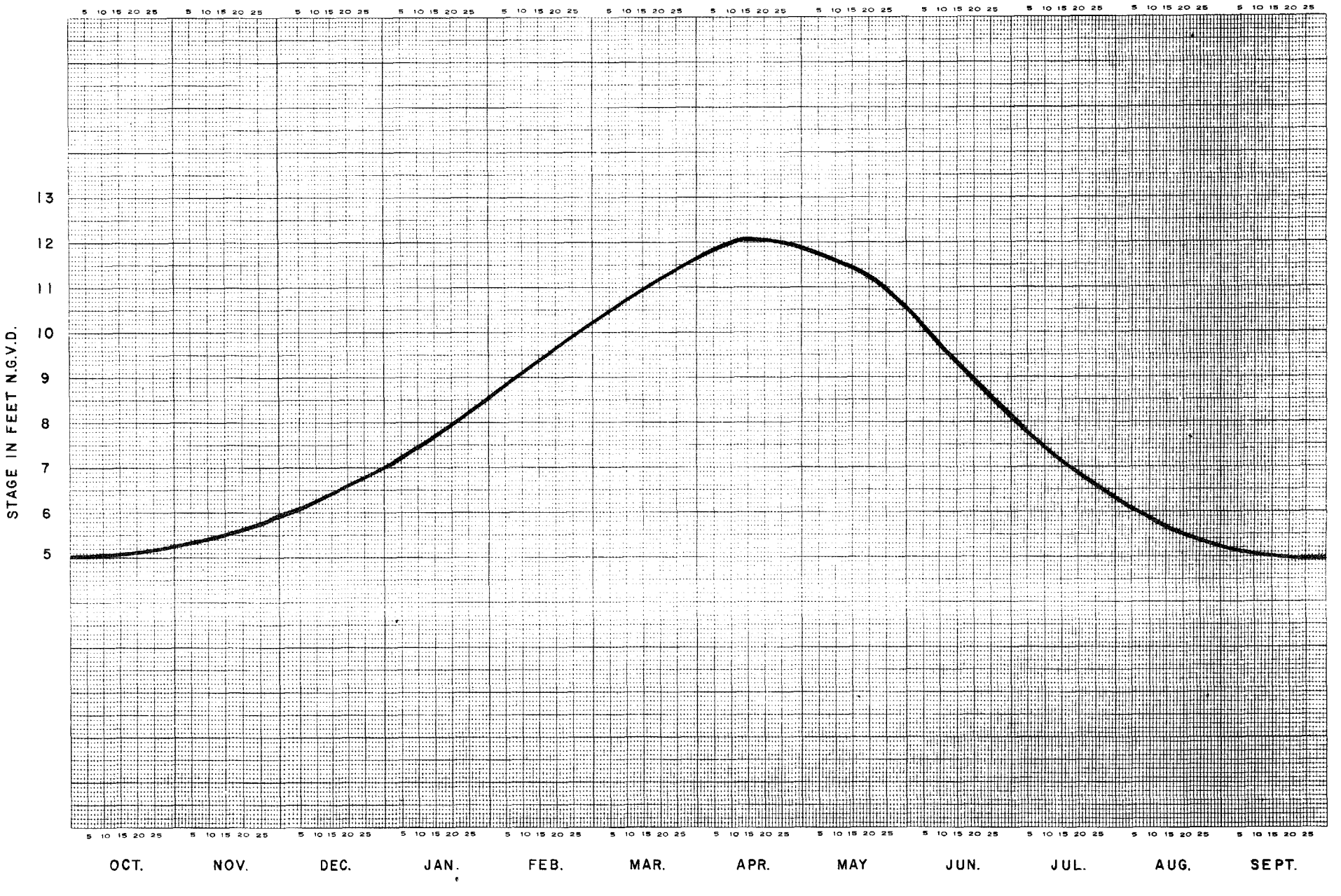


FIGURE G-6-9 THEORETICAL DESIRED HYDROGRAPH FOR FLAT LAKE

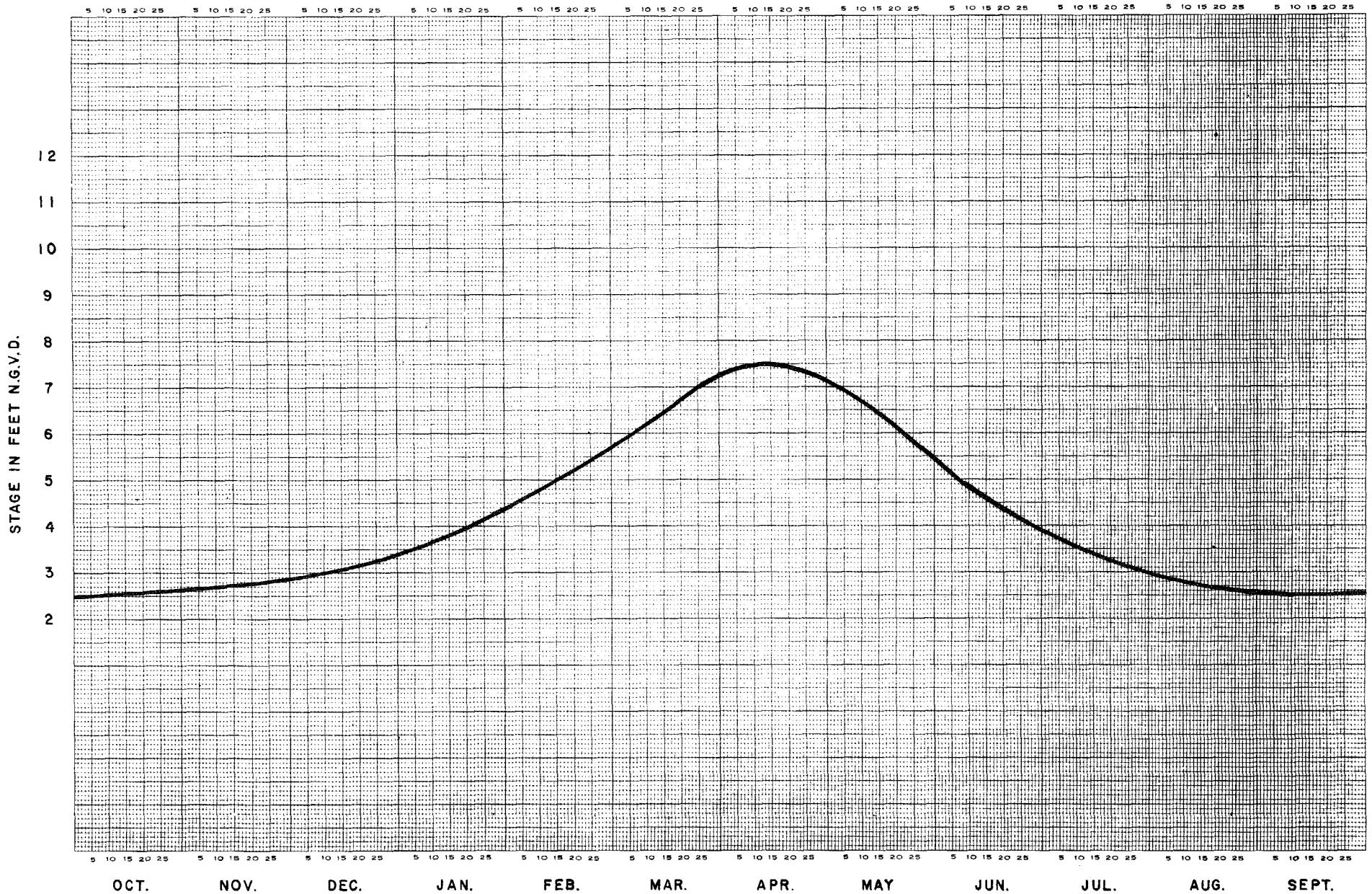


FIGURE G-6-10 THEORETICAL DESIRED HYDROGRAPH FOR SIX MILE LAKE

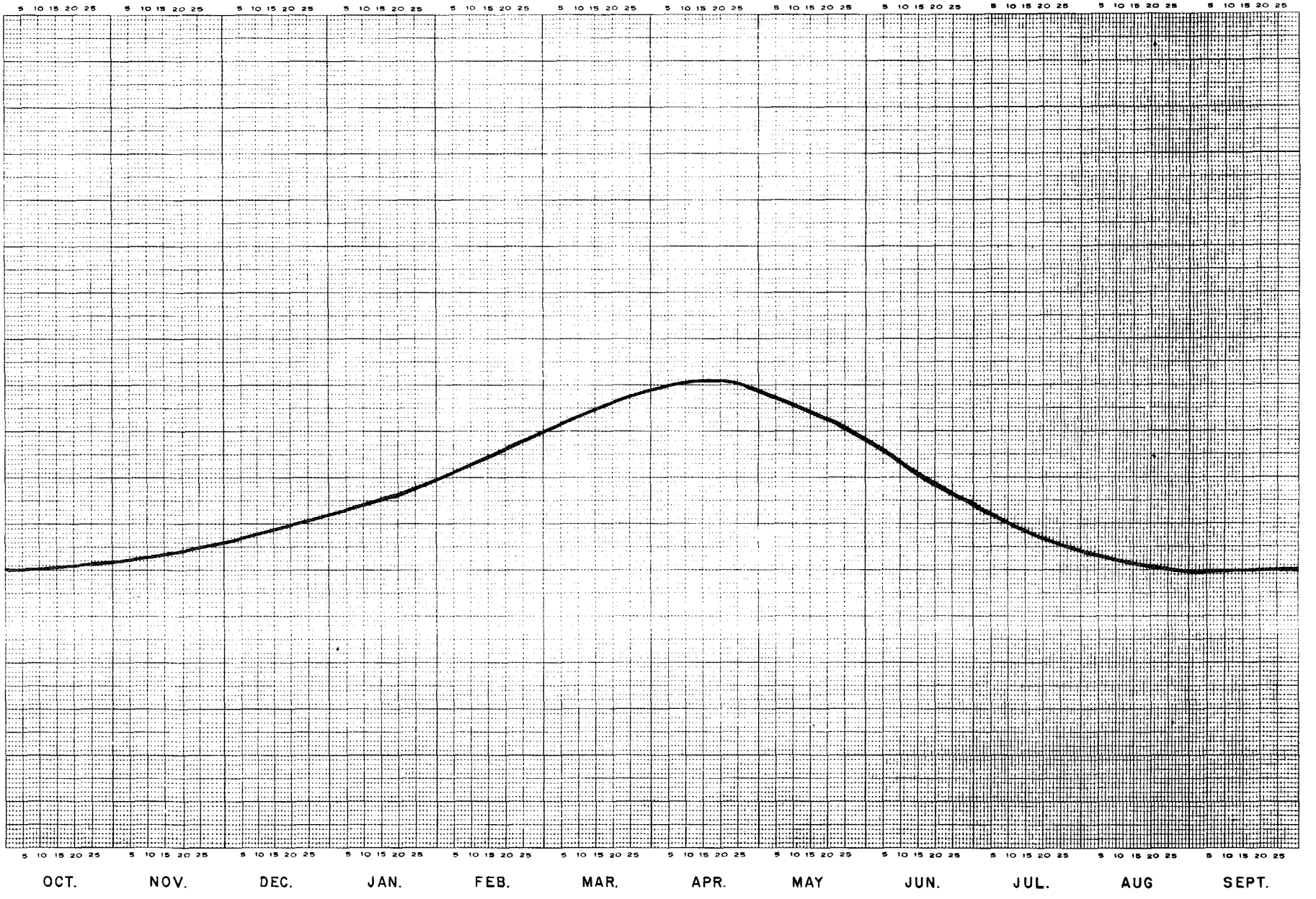
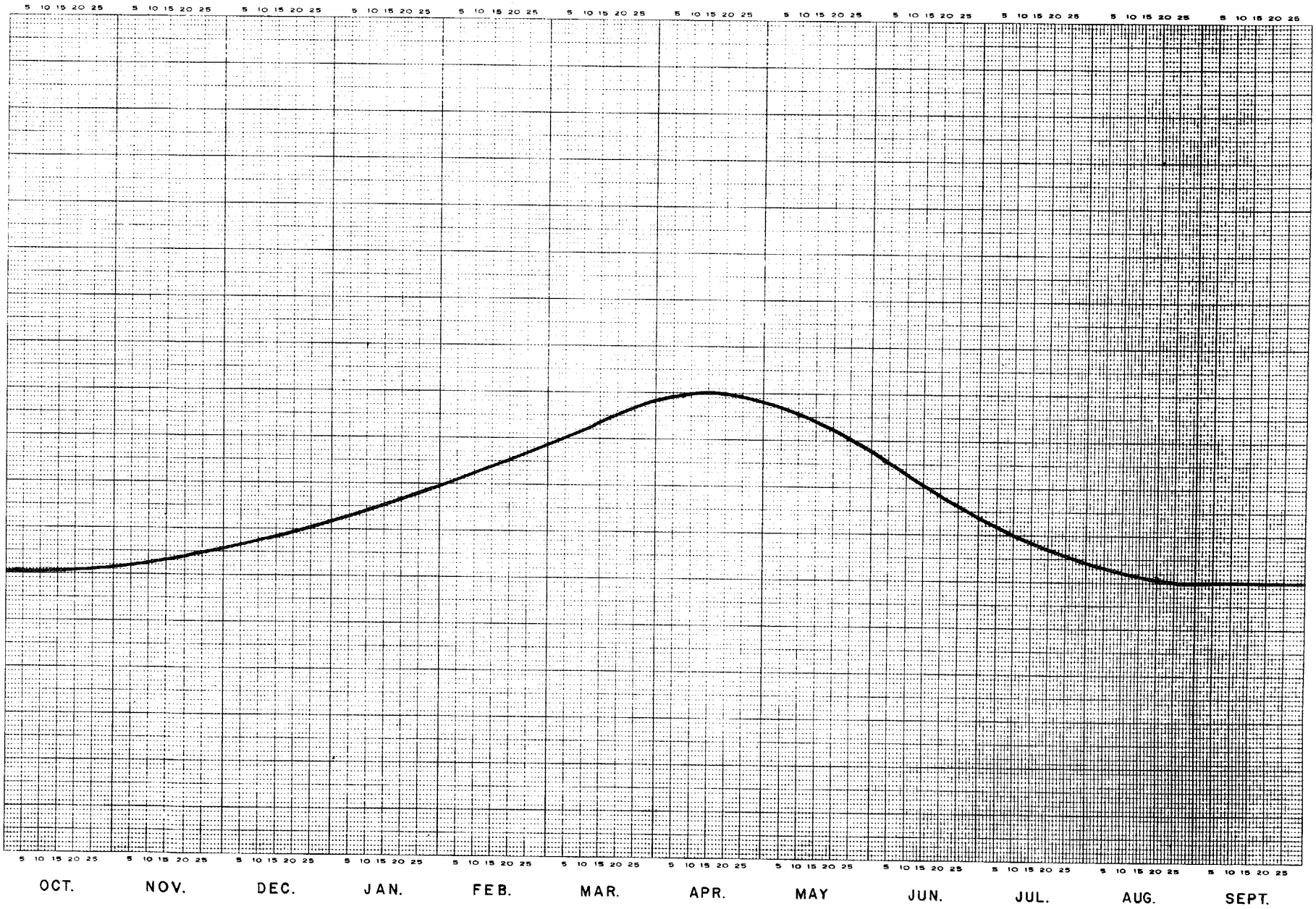


FIGURE G-6-11 THEORETICAL DESIRED HYDROGRAPH FOR UPPER BELL RIVER



of "historic" conditions. These revised theoretical desired hydrographs are shown in Figures G-6-12, G-6-13, and G-6-14.

G.6.5. Since the original November 1979 meetings, the Corps has generated new hydrographs for the floodway which more closely reflect the true nature of the annual hydrograph. These average annual shifted hydrographs are discussed and illustrated in Appendix C. A comparison of these average annual shifted hydrographs with the theoretical desired hydrographs, which were supposed to reflect an average year, revealed that the theoretical desired hydrographs were not really typical or average ones (see Figure G-6-15 through G-6-19 for examples). The theoretical desired hydrographs, in fact, reflect conditions during a year that would be wetter than average and one in which bottomland hardwood areas would experience a longer hydroperiod than would occur under average conditions. Because of this, the Corps no longer considers it desirable to attempt to duplicate the theoretical desired hydrographs, developed in November 1979, for purposes of benefitting the biological resources of the floodway, unless further detailed studies are undertaken to evaluate the possible impacts of such an action.

FIGURE G-6-12 MODIFIED THEORETICAL DESIRED HYDROGRAPH FOR FLAT LAKE

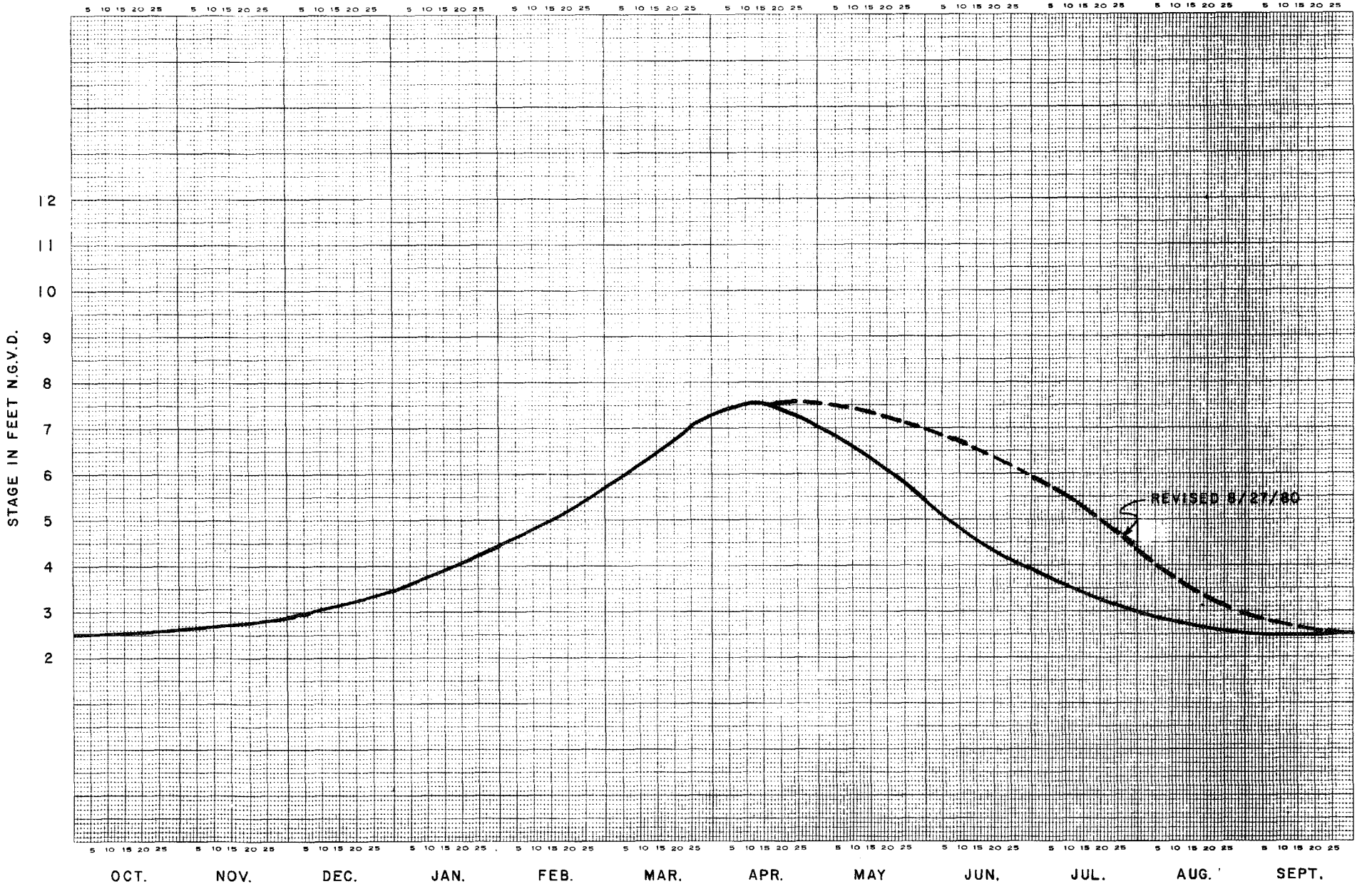


FIGURE G-6-13 MODIFIED THEORETICAL DESIRED HYDROGRAPH FOR BAYOU DES GLAISES

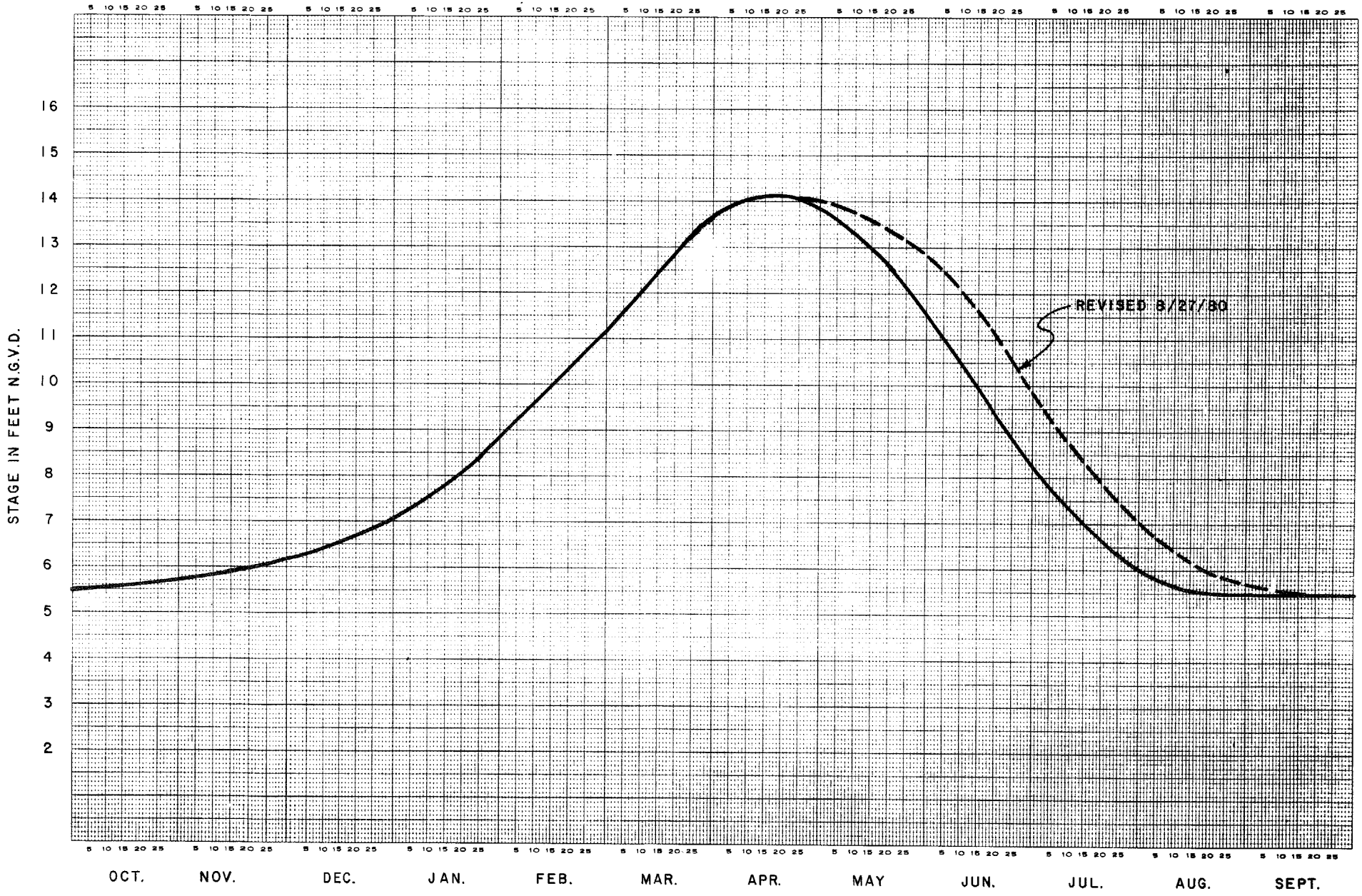


FIGURE G-6-14 MODIFIED THEORETICAL DESIRED HYDROGRAPH FOR UPPER BELLE RIVER

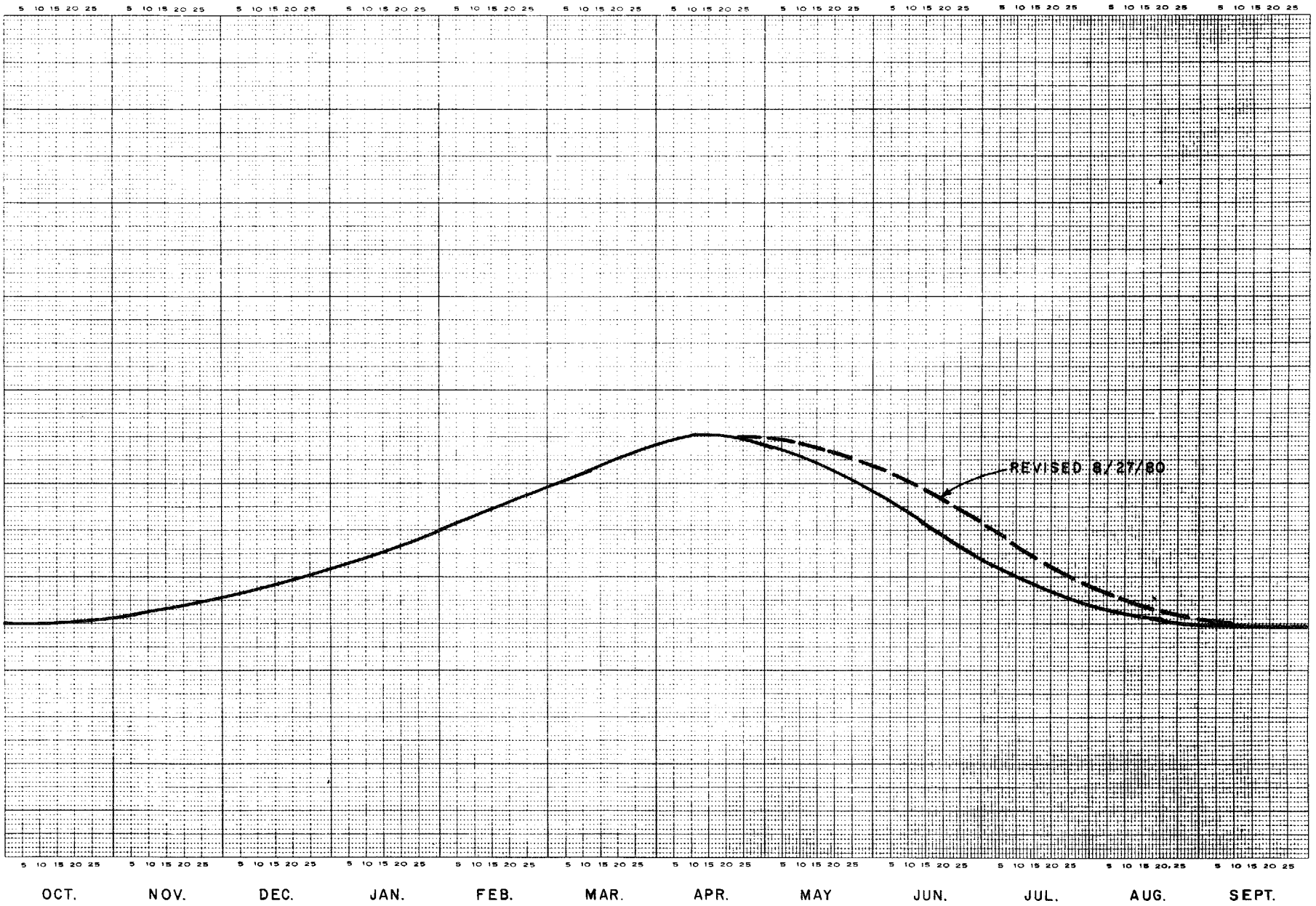


FIGURE G-6-15 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR HENDERSON

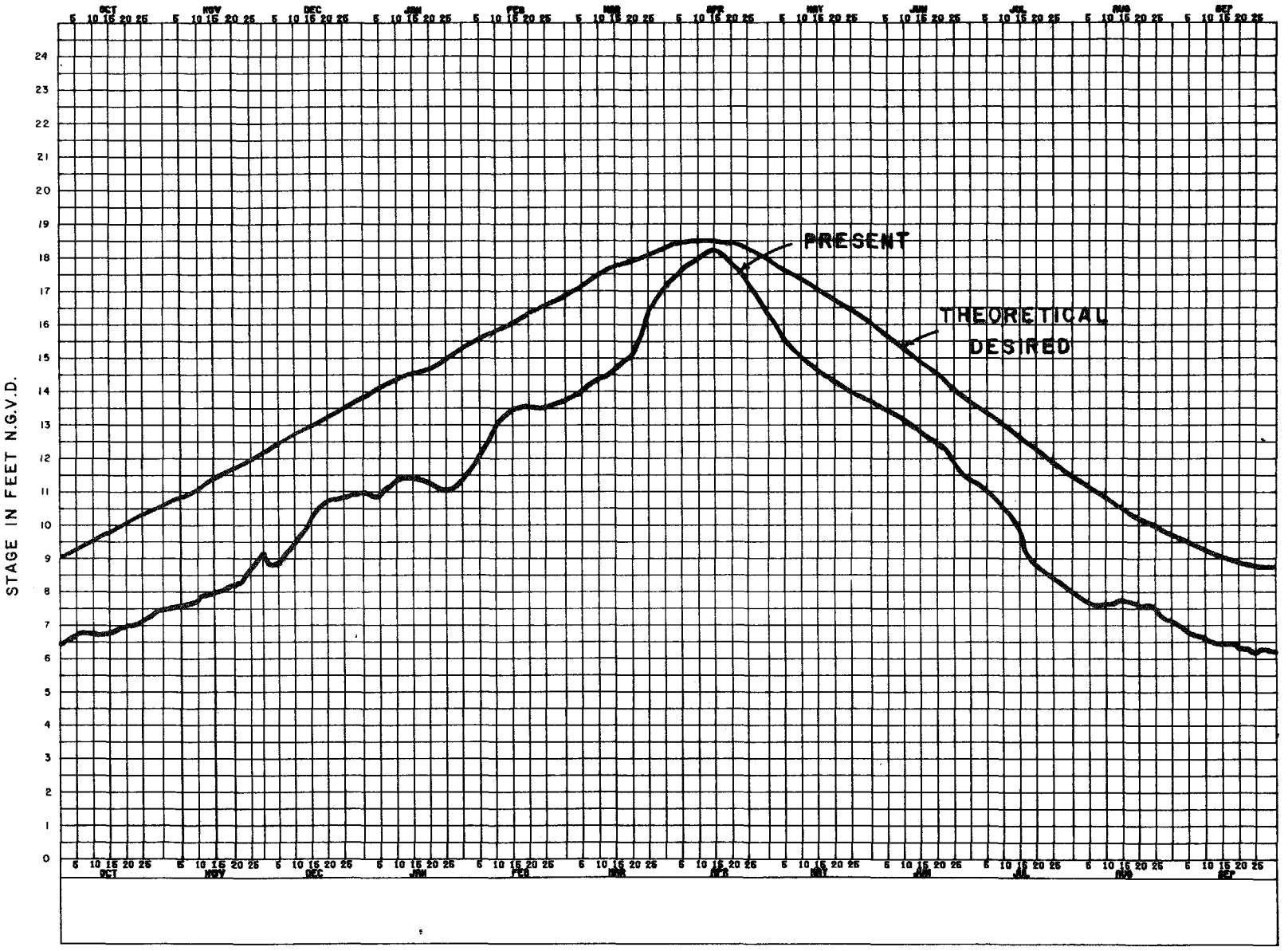


FIGURE G-6-16 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR COCODRIE SWAMP

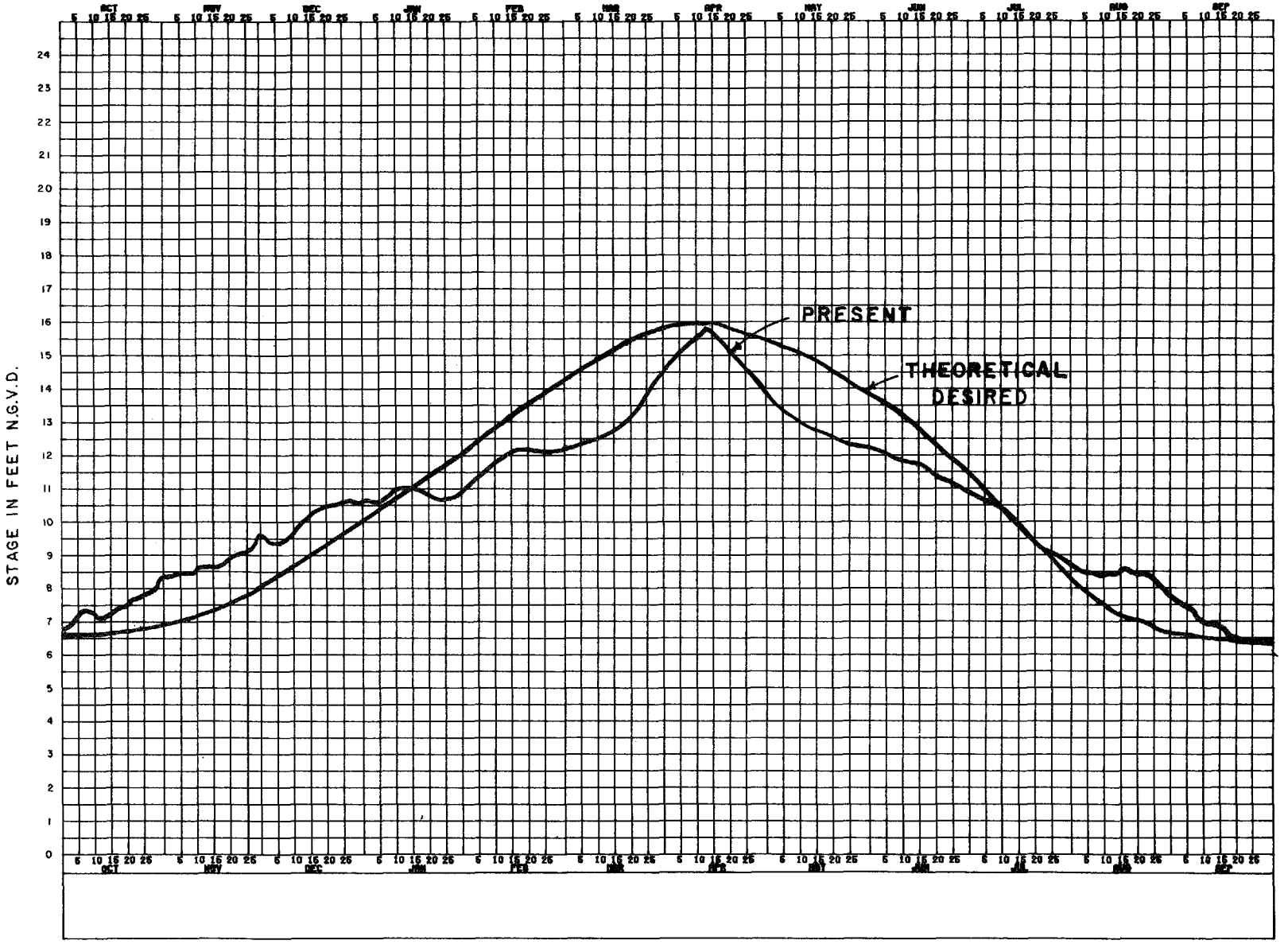


FIGURE G-6-17 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR BEAU BAYOU

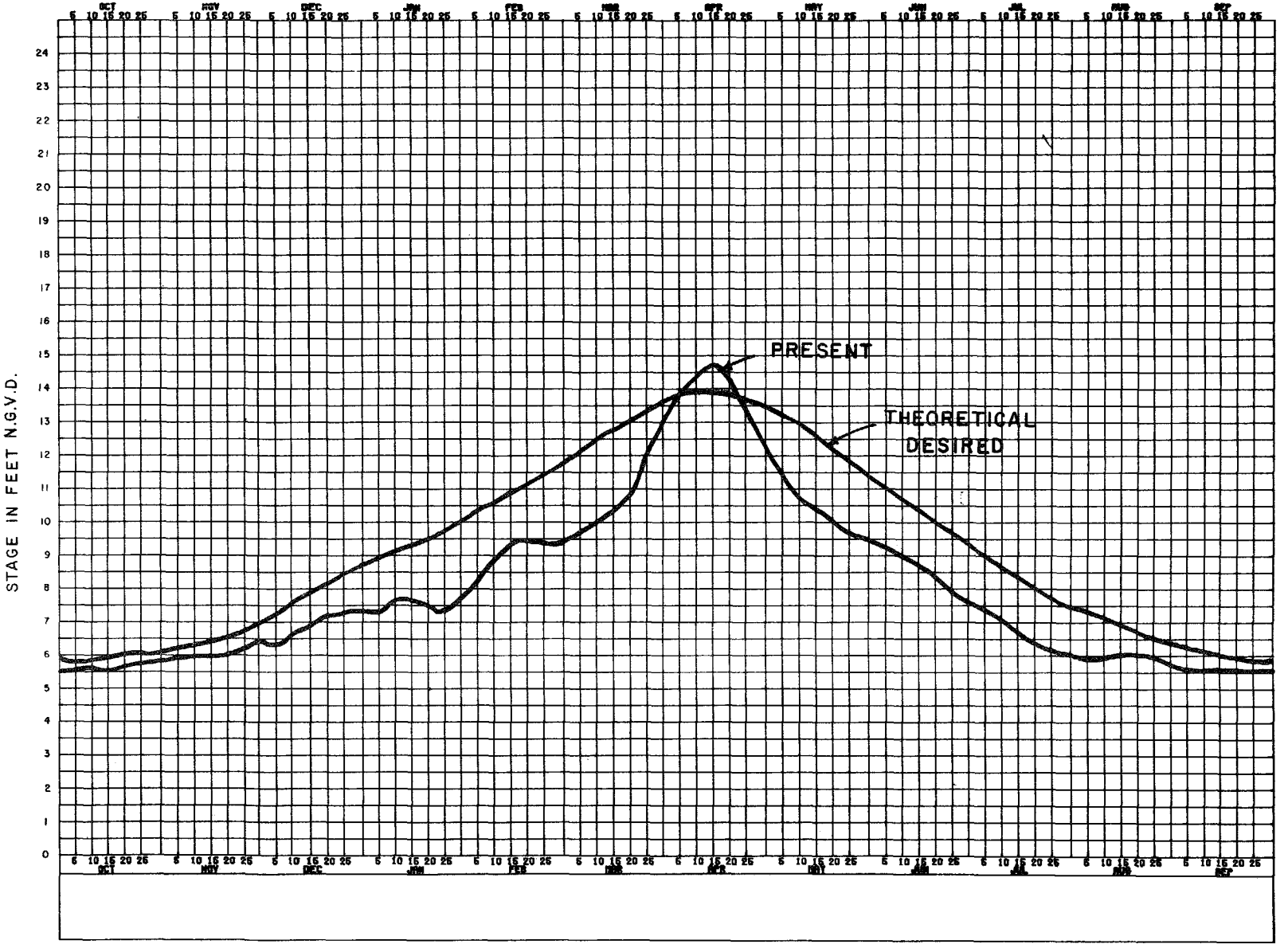


FIGURE G-6-18 THEORETICAL DESIRED HYDROGRAPH FOR BUFFALO COVE

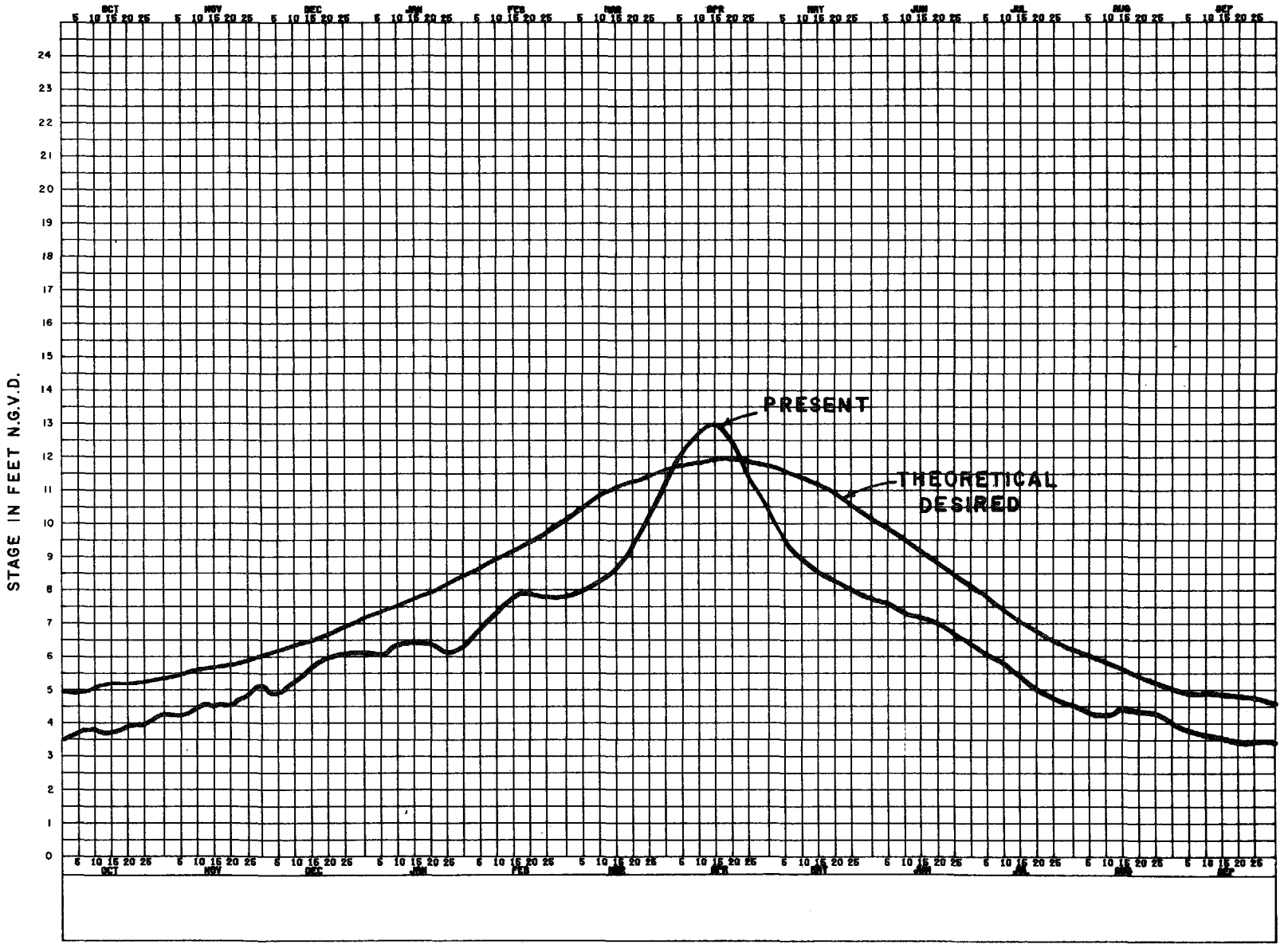
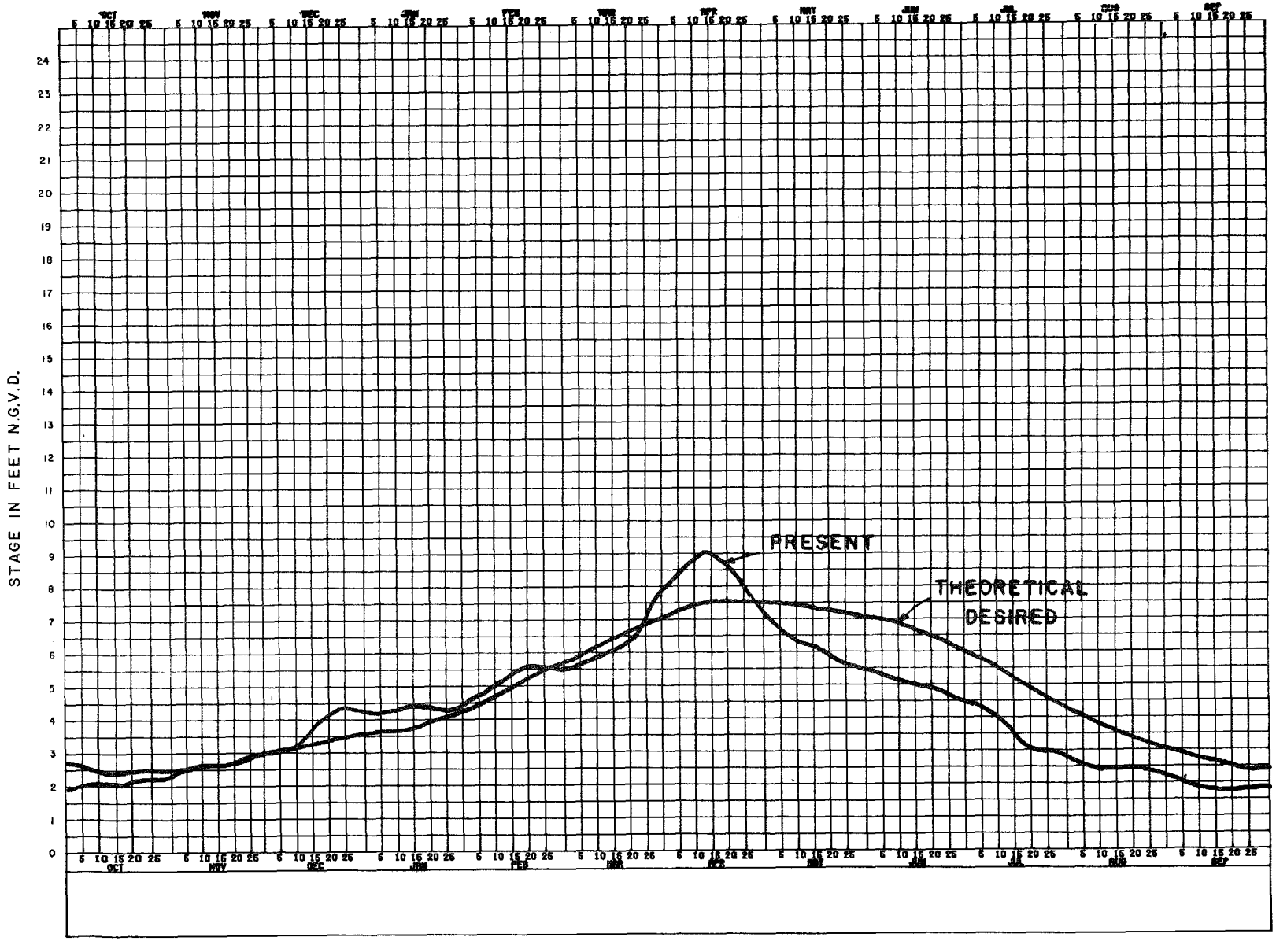


FIGURE G-6-19 PRESENT AND THEORETICAL DESIRED HYDROGRAPH FOR FLAT LAKE



Section 7 - COASTAL ZONE MANAGEMENT CONSISTENCY DETERMINATION

G.7.1. Since the State of Louisiana now has an approved Coastal Zone Management Act (The Louisiana State and Local Coastal Resources Management Act of 1978, La. R.S. 49:213.1, Act 361), any Federal agency proposing development in the coastal zone must determine if the development is consistent with state guidelines. The purpose of this appendix is to do just that. Consistency has been determined for the Recommended Plan only and not for operation and maintenance of existing features. Details of this plan are described in the Main Report/EIS and impacts are discussed in the EIS. It must be pointed out that the Corps is not making a recommendation on the Avoca Island levee at this time. Since the recommended plan contains numerous features, the consistency of each feature has been determined. Table G-7-1 summarizes each guideline and indicates the status of each feature in relation to each guideline. Wherever necessary, the consistency of a feature is discussed by guideline in subsequent paragraphs.

G.7.2. Guideline 1.7a - Channel training above Morgan City would reduce sediments carried into adjacent forested wetlands. This reduction would aid in preserving the wetlands. Channel training along the lower Atchafalaya River and Wax Lake Outlet would reduce the amount of riverborne sediments and nutrients that reach adjacent marshes; however, gaps left in the training works would allow some river overflow. At present, it appears that this channel training is probably one of the more feasible and practicable methods of causing a reduction in flowline. Changes in flows at the outlets would change the sediment distribution, but the total amount of sediment delivered to Atchafalaya Bay would not change. Thus, all these features are consistent with this guideline to the maximum extent practicable.

G.7.3. Guideline 1.7b - Channel training north of Morgan City, management units and work at the outlets, would both cause some adverse economic impacts by interruption of navigation. However, the environmental and/or other economic benefits of these features would outweigh this slight loss and thus, all features are consistent to the maximum extent practicable.

G.7.4. Guideline 1.7d - All features would cause a temporary and localized reduction in dissolved oxygen during construction. Management units, by reducing the amount of water flowing through them, could reduce dissolved oxygen levels from present levels.

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
1.1	Guidelines must be read in their entirety.	Acknowledged							
1.2	Conformance with applicable water and air quality law is necessary.	Acknowledged							
1.3	General and specific guidelines are included. If inconsistent, specific apply.	Acknowledged							
1.4	Guidelines shall not consist in involuntary taking of property.	Acknowledged							
1.5	No use shall violate terms of a grant of or waterbottoms to the State.	Acknowledged							
1.6	Information regarding numerous general factors shall be utilized in evaluating compliance.	Acknowledged							
1.7a	Avoid reduction in sediment and nutrients.	C	C	C*	C**	C*	C	C*	C
1.7b	Avoid adverse economic effects.	C	C	C*	C	C	C*	C*	C
1.7c	Avoid detrimental discharge of inorganic nutrients.	C	C	C	C	C	C	C	C
1.7d	Avoid alternation of oxygen in water.	C	C*	C*	C*	C*	C*	C*	C*
1.7e	Avoid destruction of wetlands and water bodies.	C	C*	C*	C**	C*	C*	C*	C*
1.7f	Avoid disruption of existing social patterns.	C	C*	C*	C	C*	C*	C	C
1.7g	Avoid alteration of temperature.	C	C*	C*	C*	C*	C*	C*	C*
1.7h	Avoid detrimental change in salinity.	C	C	C	C	C	C	C	C
1.7i	Avoid detrimental changes in sediment transport.	C	C	C*	C**	C*	C	C	C
1.7j	Avoid adverse effect of cumulative impacts	C	C*	C*	C**	C*	C*	C*	C*

C = feature is consistent with the guideline to the maximum extent practicable.

C* = feature is consistent with guideline to maximum extent practicable and is discussed in accompanying text.

C** = some doubt exists whether this feature is consistent with the guideline to maximum extent practicable. Matter is
discussed in text.

N/A = guideline does not apply to feature in question.

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
1.7k	Avoid detrimental discharge of suspended solids.	C	C*	C*	C*	C*	C*	C*	C*
1.71	Avoid blockage of natural circulation.	C	C	C*	C*	C*	C*	C*	C*
1.7m	Avoid discharge of pathogens or toxic substances.	C	C	C	C	C	C	C	C
1.7n	Avoid destruction or alteration of archeological or historical resources.	C	C*	C*	C*	C*	C*	C*	C*
1.7o	Avoid detrimental secondary effects.	C	C	C	C**	C	C	C	C
1.7p	Avoid adverse alteration of wildlife management areas.	C	C	C*	C	C	C*	C	C
1.7q	Avoid adverse alteration of parks and recreation areas, etc.	C	C	C	C	C	C	C	C
1.7r	Avoid disruptions of wildlife and fishery migratory patterns.	C	C	C*	C	C	C*	C	C
1.7s	Avoid land loss, erosion, and subsidence.	C	C	C	C**	C*	C	C	C
1.7t	Avoid increase in flood potential.	C*	C*	C*	C*	C*	C*	C*	C*
1.7u	Avoid reduction in long-term biological productivity.	C	C	C	C**	C*	C*	C	C*
1.8	If benefits clearly outweigh adverse impacts of non-compliance and there are no feasible alternatives, and significant public beneftis result, or the use would serve important interests, or is water dependent, the use will be in compliance.	Acknowledged							
1.9	Uses shall permit multiple concurrent uses and avoid unnecessary conflicts with other uses.	C*	C*	C*	C*	C*	C*	C*	C*
1.10	Guidelines shall not expand governmental authority.	Acknowledged							
2.1	Leveeing of biologically productive wetlands shall be avoided.	N/A	C*	N/A	N/A	N/A	C*	C*	C*

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Management Units	Outlets	Widen WLO Overbank
2.2	Levees shall be sited to avoid segmentation of wetland systems.	N/A	C	N/A	N/A	N/A	C*	C*	C*
2.3	Levees for development shall be avoided.	N/A	C	N/A	N/A	N/A	C	C	C
2.4	Hurricane and flood protection levees should be at the wetland/non-wetland interface.	N/A	C*	N/A	N/A	N/A	C*	C*	C*
2.5	Impoundment levees only constructed as part approved water management project.	N/A	C	N/A	N/A	N/A	C*	C	C
2.6	Levees shall use best practicable techniques to minimize disruption of interchange of organisms, nutrients, and water.	N/A	C	N/A	N/A	N/A	C	C	C
3.1	Linear facilities shall avoid areas of high biologic productivity.	N/A	N/A	C*	C**	N/A	N/A	N/A	N/A
3.2	Avoid use of dredging or filling to maximum extent practicable.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.3	Facilities involving dredging shall be minimum length.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.4	Pipelines should be installed by bush ditch method and backfilled.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.5	Existing corridors should be utilized.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.6	Linear facilities shall permit multiple use.	N/A	N/A	C*	C**	N/A	N/A	N/A	N/A
3.7	Linear facilities shall avoid barrier islands.	N/A	N/A	C	C	N/A	N/A	N/A	N/A
3.8	Linear facilities shall not traverse gulf shoreline.	N/A	N/A	C	C	N/A	N/A	N/A	N/A
3.9	Linear facilities should avoid disruption of hydrologic and sediment transport and minimize adverse impacts on wetlands.	N/A	N/A	C*	C**	N/A	N/A	N/A	N/A
3.10	Linear facilities should prevent bank erosion and saltwater intrusion.	N/A	N/A	C	C	N/A	N/A	N/A	N/A
3.11	Canals connecting areas of differing salinity shall be plugged.	N/A	N/A	C	C	N/A	N/A	N/A	N/A

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
3.12	Multiple use and directional drilling shall be used for canals.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.13	Pipeline construction codes.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.14	Canals backfilled.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.15	Sites revegetated.	N/A	N/A	C*	C*	N/A	N/A	N/A	N/A
3.16	Dead-end canals shall be avoided.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4.1	Spoil shall be disposed to avoid disruption of water movement, flow, circulation, and quality.	N/A	N/A	N/A	N/A	C*	N/A	N/A	C*
4.2	Spoil shall be used to improve environmental productivity or upland disposal areas shall be used.	N/A	N/A	N/A	N/A	C*	N/A	N/A	C*
4.3	Spoil shall not impound or drain wetlands.	N/A	N/A	N/A	N/A	C	N/A	C	C
4.4	Spoil shall not be disposed on marsh, reefs, or grass beds.	N/A	N/A	N/A	N/A	C	N/A	C	C*
4.5	Spoil shall not be disposed to hinder navigation, fishing, or timber growth.	N/A	N/A	N/A	N/A	C*	N/A	C	C
4.6	Spoil areas shall be designed to retain spoil at the site, reduce turbidity, and reduce erosion.	N/A	N/A	N/A	N/A	C	N/A	C	C
4.7	Alteration of state-owned property shall not occur without consultation with Department of Natural Resources.	N/A	N/A	N/A	N/A	C	N/A	C	N/A
5.1-5.9		No shoreline modifications are proposed.							
6.1	Industrial, commercial, urban, residential, and recreational uses shall be encouraged in suitable areas.	No such uses are proposed.							
6.2	Levees, roads, etc., shall be built only to protect areas suitable for development and when they are consistent with other guidelines and land use plans.	N/A	C*	C	C	C	C*	C*	C*
6.3	Deleted.	Acknowledged							
6.4	Wetland areas shall not be drained or filled. Property damage and adverse environmental impacts shall be minimized.	N/A	C*	C*	C*	C*	C*	C*	C*

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
6.5	Coastal water dependent uses given special consideration.	Acknowledged							
6.6	Modified areas shall be returned to predevelopment condition after use.	N/A	C*	C*	C*	C*	C*	C*	C*
6.7	Site clearing shall be limited to immediate construction area.	N/A	C	C	C	C	C	C	C
6.8	Alterations shall be located away from critical wildlife and vegetation areas. ALterations in wildlife management areas shall be in accord with require-ments of wildlife management body.	N/A	C	C*	C	C	C*	C	C
6.9	Adverse impacts shall not occur on barrier islands, cheniers, natural levees, wildlife or fishery breeding or spawning areas or migratory routes.	N/A	C*	C*	C*	C*	C*	C*	C*
6.10	Creation of low dissolved oxygen or traps for heavy metals shall be avoided.	N/A	C*	C*	C*	C*	C*	C*	C*
6.11	Surface mining and shell dredging shall use best practicable techniques.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.12	Creation of underwater obstructions shall be avoided.	N/A	C	C	C	C	C*	C	C
6.13	Release of pollutants and toxic susbstances shall be avoided.	N/A	C	C	C	C	C	C	C
6.14	Only contaminant-free material shall be used as fill	N/A	C	C	C	C	C	C	C
7.1	Controlled diversion of sediment-laden waters to create and nourish marsh shall be encouraged.	N/A	N/A	C*	C*	C*	C*	C*	N/A
7.2	Sediment deposition shall be part of an approved plan and offset land loss or create or restore wetlands.	N/A	N/A	C	C	C	C	C	N/A
7.3	Sediment shall not be deposited in sensitive habitat or navigation areas.	N/A	N/A	C*	C*	C	C	C	N/A
7.4	Diversion of freshwater through siphons to introduce nutrients shall be encouraged; includes a monitoring plan.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE G-7-1

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES

		PLAN FEATURES							
		70/30	Levee Raising	Channel Training AR	Channel Training LAR	Sediment Reduction	Manage-ment Units	Outlets	Widen WLO Overbank
7.5	Water or marsh managment plans shall result in overall benefit to productivity.	N/A	N/A	N/A	N/A	N/A	C*	N/A	N/A
7.6	Water control structures shall be assessed separately on their own merits.	N/A	N/A	N/A	N/A	N/A	C	N/A	N/A
7.7	Weirs shall be designed to prevent "cut around".	N/A	N/A	N/A	N/A	N/A	C	C	N/A
7.8	Impoundments shall not be constructed in brackish or saline areas.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7.9	Withdrawal of water shall not result in saltwater intrusion.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8.1-8.9	Waste disposal.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9.1	Upland water management programs shall preserve or enhance existing water quality volume and rate of flow.	C	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9.2	Runoff from developed areas shall simulate natural quantity, quality and rate of flow.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9.3	Runoff and erosion from agricultural lands shall be minimized.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.1-10.14	Oil, gas and other mineral activities.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

However, oxygen levels in all probability, would be higher than under future conditions without management units. Thus, all features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.5. Guideline 1.7e - Levee raising would destroy wetlands and water bodies, but the benefits gained would outweigh the loss of wetlands. There are no feasible and practicable alternatives to levee raising for flood protection. Channel training above Morgan City would also destroy wetlands, but it would also protect wetlands by preventing sedimentation. The wetlands saved and the flood protection gained by this feature would be significant public benefits. Channel training below Morgan City would destroy wetlands and water bodies. For a discussion of the benefits of this feature, see discussion of guideline 1.7a. Sediment reduction by distributary realinement would destroy wetlands, but would preserve more wetlands than it would destroy. Management units would destroy wetlands, but the benefits they would accrue to the aquatic ecosystem, by preserving water bodies, would outweigh the wetland destruction. Control of flow at the outlets would cause the destruction of some wetlands, but the increased outlet capacity realized by this feature would aid in flood control. Other diversions of outlet flow could be constructed, but all would involve a weir and levee, so construction of these features is the only practicable method of increasing the outlet capacity. Widening of Wax Lake Outlet overbank would destroy wetlands, but would also reconnect 7,800 acres of wetlands to the riverine and tidal systems. Thus, all the above features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.6. Guideline 1.7f - Channel training in the main channel above Morgan City would disrupt boat traffic toward Duck Lake and toward the south also. Construction of managment units would make access difficult, since only the inlets and outlets could be used by crew boats and larger recreational craft. Small boats could utilize rollovers unless loaded with crawfish. However, the management units would preserve aquatic habitat longer than the without condition. Levee raising and sediment reduction would both displace camps, which would disrupt social patterns. However, the flood control benefits would outweigh these adverse social impacts. All features are considered to be consistent to the maximum extent practicable.

G.7.7. Guideline 1.7g - All features that increase turbidity would slightly raise water temperatures, but this effect would be local and temporary but features would be in compliance with the guideline. Increasing the amount of cold river water entering the eastern portion of Atchafalaya Bay would slightly lower the temperature, but the effect should not be significant. All features are considered to be consistent with this guidline to the maximum extent practicable.

G.7.8. Guideline 1.7h - The possible future change in outlet percentages would slightly freshen Atchafalaya Bay and make East Cote

Blanche Bay somewhat more brackish. This change should not be detrimental; therefore, the feature is in compliance.

G.7.9. Guideline 1.7i - Channel training and sediment reduction would prevent sediment deposition in the floodway and marshes, thereby providing more sediment to the littoral transport system than there is now. These features are considered to be in compliance with guideline 1.7i to the maximum extent practicable.

G.7.10. Guideline 1.7j - All features would add to cumulative adverse environmental impacts already occurring in the coastal zone. Channel training in the Atchafalaya River, sediment reduction, widening Wax Lake Outlet overbank, and management units would all destroy wetlands, but would have beneficial environmental impacts, such as reducing sedimentation in wetlands or preserving the aquatic ecosystem. Levee raising and control of the outlets would add to cumulative impacts, but are a necessary part of the flood control plan with substantial social benefits. The benefits of channel training in the lower river are described under guideline 1.7a. Thus, it is felt that all features comply with guideline 1.7j to the maximum extent practicable.

G.7.11. Guideline 1.7k - All features would cause a temporary and localized discharge of suspended solids into the coastal system during construction. Turbidity would occur only in the vicinity of the work and would be short-lived. All features comply with this guideline to the maximum extent practicable.

G.7.12. Guideline 1.7l - Channel training above Morgan City would block natural circulation, but also reduce overbank sedimentation into wetlands and lower the flood flowline. Channel training below Morgan City would do the same, but the lost sediment would have nourished the marshes. Distributary realinement would slightly change circulation patterns and produce environmental benefits. Management unit construction would seal off some natural and man-made canals in order to preserve the aquatic ecosystem within the unit. Construction of a weir and levee at the outlets would block circulation, but provide additional channel capacity at the outlets. The levee constructed adjacent to the Bayou Sale ridge during widening of Wax Lake Outlet would prevent natural runoff into the swamp from the ridge. However, degradation of the existing levees along the west side of Wax Lake Outlet would add 7,800 acres to the riverine and tidal systems. Thus, these features are consistent with this guideline to the maximum extent practicable.

G.7.13. Guideline 1.7n - Only the levee raising feature of the tentatively selected plan has been subject to an intensive cultural resources survey. The survey located National Register eligible site 16SM45 and 11 additional cultural resources possibly eligible for inclusion in the National Register in the project corridor. The effects of the levee enlargement feature of this plan upon each of

these significant cultural resources is currently being determined. Cultural resources surveys of all other project features will be completed prior to construction and any Register or Register-eligible properties will be avoided, protected, or, in the absence of a feasible alternative, mitigated by data recovery. Thus, all features are consistent to the maximum extent practicable.

G.7.14. Guideline 1.7o - The channel training below Morgan City could reduce input of riverborne sediments into marshes which could increase the loss rate of these lands. The adverse secondary impact would probably be outweighed by the beneficial impacts described under guideline 1.7a.

G.7.15. Guideline 1.7p - Channel training above Morgan City would alter portions of the Attakapas Wildlife Management Area from river miles 90 to 95. This feature would preserve wetlands in the same area and lower the flood flowline. Thus, it is considered consistent with guideline 1.7p to maximum extent practicable. Management units would hinder boat access into the Buffalo Cover portion of this management area. However, units would preserve aquatic habitat in the area and are therefore considered to be consistent to the maximum extent practicable.

G.7.16. Guideline 1.7r - Channel training above Morgan City could disrupt migratory patterns of amadromous and catadromous fishes, but the 17-mile restriction should not cause severe problems. Management units would also disrupt migratory patterns of such fish by closing numerous bayous and canals. The benefits these units would have to the aquatic system should far outweigh the adverse impacts. Thus, these features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.17. Guideline 1.7s - Distributary realinement would increase the amount of sediment available for delta building in Atchafalaya Bay and is considered consistent with this guideline to the maximum extent practicable. Channel training below Morgan City would reduce riverborne sediment introduction into adjacent marshes, which would increase the land loss rate in these marshes. The benefits of this feature are discussed under guideline 1.7a.

G.7.18. Guideline 1.7t - All features would decrease the potential of flooding and are consistent with this guideline to the maximum extent practicable.

G.7.19. Guideline 1.7u - Sediment reduction, management units, and widening Wax Lake Outlet overbank would all increase long-term aquatic biological productivity of the coastal ecosystem and therefore are consistent with this guideline.

G.7.20. Guideline 1.9 - In general, multiple concurrent uses are not practicable with the exception that the raised levees serve as roads

in certain places. All features are considered in compliance with this guideline to the maximum extent practicable.

G.7.21. Guideline 2.1 - The raising of the protection levees would not inclose any wetlands, but would destroy wetlands during construction. However, the flood control benefits would outweigh the adverse impacts of wetland loss as described under guideline 1.7e. Management units would basically levee wetlands, but this leveeing would increase aquatic productivity over future without-project conditions. The levee built to control flow at the outlets would not impound wetlands, nor would the levee along the widened Wax Lake Outlet. Benefits are discussed under guideline 1.7e. Hence, these features are consistent with this guideline to the maximum extent practicable.

G.7.22. Guideline 2.2 - Management units would complete the segmentation of wetland areas that are nearly segmented at the present time. The levee for outlet control would not segment wetland areas. The levee for widening Wax Lake Outlet would not significantly segment wetland areas, since it will be located near the wetland/ridge interface. Thus, all these features are consistent with guideline 2.2.

G.7.23. Guideline 2.3 - Most of the levees in this project would not be built for the purpose of developing or otherwise changing the use of wetlands; therefore, these features are consistent with this guideline.

G.7.24. Guideline 2.4 - The raising of the protection levees would be at the wetland/non-wetland interface. The few levees necessary to complete the segmentation of management units would also be at the water/land interface. The levee to control flow at the outlets would be along the riverbank, which is basically a wetland/non-wetland interface. The levee along the widened Wax Lake Outlet overbank would be near the interface. All these levees are consistent with guideline 2.4 to the maximum extent practicable.

G.7.25. Guideline 2.5 - Levees completing the encirclement of management units are the only impoundment levees proposed in this project. The management units are a vital part of a water management plan that would help preserve the aquatic ecosystem. Thus, this feature is considered consistent with this guideline to the maximum extent practicable.

G.7.26. Guideline 3.1 - For purposes of this consistency determination, the channel training works are considered linear facilities. Channel training above Morgan City would destroy some forested wetlands but would protect additional acres from sedimentation. Thus, it is consistent with this guideline to the maximum extent practicable. Channel training below Morgan City would destroy marsh directly and increase land loss in adjacent marsh. The benefits of this feature are discussed under guideline 1.7a.

G.7.27. Guideline 3.2 - Channel training above Morgan City utilizes dredged material, but gains environmental benefits. Channel training below Morgan City does attempt to avoid deposition of dredged material in wetland by leaving gaps in the training works. These features are consistent with this guideline to the maximum extent practicable.

G.7.28. Guideline 3.3 - The channel training works are of the minimum practical length and are consistent with this guideline to the maximum extent practicable.

G.7.29. Guideline 3.5 - The existing riverbank would be utilized for these channel training work; thus, both features are consistent with the guideline to the maximum extent practicable.

G.7.30. Guideline 3.6 - Channel training above Morgan City would "share" 5 miles of levee with the outlet control feature; therefore, it is consistent with the guideline to the maximum extent practicable. Channel training below Morgan City has no multiple use; its benefits are described under guideline 1.7a.

G.7.31. Guideline 3.9 - Channel training would disrupt overflow and sediment transport to adjacent wetlands. Works above Morgan City would preserve forested wetlands by sediment reduction and therefore are consistent with this guideline to the maximum extent practicable. Works below Morgan City would not have similar beneficial environmental effects; their flood benefits are described under guideline 1.7a.

G.7.32. Guideline 3.15 - The channel training works would revegetate naturally with early successional bottomland hardwoods in one to two growing seasons. The features are consistent with this guideline to the maximum extent practicable.

G.7.33. Guideline 4.1 - This series of guidelines would apply to the distributary realinement feature, where some dredged material would be disposed on land near the Old Atchafalaya River and most would be deposited in the main channel. The disruption to water flow circulation and quality caused by this feature would be minor. Water quality would be temporarily lowered by construction turbidity, but water quality within swamps would be improved by sediment reduction. Thus, this feature is consistent with guideline 4.1 to the maximum extent practicable. This series also would apply to material created by degradation of the existing Wax Lake Outlet overbank levees. The material would be either hauled to build the new levee or utilized to backfill the borrow pit. In neither case would it disrupt water circulation and it is therefore consistent with this guideline to the maximum extent practicable.

G.7.34. Guideline 4.2 - An upland disposal area would be used at Old Atchafalaya River. The levee material utilized to backfill the borrow

pit at Wax Lake Outlet would create marsh. The remainder would be utilized for upland disposal. Thus, these features are consistent with this guideline to the maximum extent practicable.

G.7.35. Guideline 4.4 - A small amount of marsh would be destroyed by widening the Wax Lake Outlet overbank area. The beneficial impacts of this feature would outweigh this adverse impact; and thus, this feature is considered consistent to the maximum extent practicable.

G.7.36. Guideline 4.5 - When land disposal is utilized at Old Atchafalaya River and Wax Lake Outlet overbank, some trees may be destroyed and growth of others hindered. However, the environmental benefits realized by these features would far outweigh the losses. Thus, these features are considered to be consistent to the maximum extent practicable.

G.7.37. Guideline 6.2 - The raising of the protection levees would protect areas already protected. Levees necessary for management units would attempt to preserve the aquatic ecosystem within the units. The levees at the outlets and at widened Wax Lake Outlet overbank would increase outlet capacity and have desirable environmental benefits. Thus, these features are consistent with this guideline to the maximum extent practicable.

G.7.38. Guideline 6.4 - Levee raising, channel training, sediment reduction, management units, the levee at the outlets, and the levee along the widened Wax Lake Outlet overbank are all in wetlands but, as discussed under guideline 1.7e, social benefits would be substantial, making these features consistent with this guideline to the maximum extent practicable.

G.7.39. Guideline 6.6 - The levees necessary to complete the management units channel training works, and distributary closures would revegetate with early successional forest. The raised protection levees, the levees controlling the outlets, and the levees at the widened Wax Lake Outlet overbank would be in use for the life of the project and could not be returned to predevelopment condition. Thus, all features are consistent with this guideline to the maximum extent practicable.

G.7.40. Guideline 6.8 - The levees completing the Buffalo Cove management unit would disrupt access into Attakapas Wildlife Management Area. However, the management unit would help maintain fishery productivity in the management area. Channel training above Morgan City would alter a small portion of the Attakapas Wildlife environmental benefits would outweigh the loss. These features are believed to be in compliance with the guideline to the maximum extent practicable.

G.7.41. Guideline 6.9 - Levee raising of protection levees, channel training works, distributary realinement, management unit levees,

outlet levees, and the levee along the widened Wax Lake Outlet would all destroy wetlands, the breeding and spawning areas for fish, shellfish, waterfowl, etc. But, all of these features are consistent with this guideline to the maximum extent practicable, either because they have substantial flood control benefits or because they preserve environmental values.

G.7.42. Guideline 6.10 - Construction of all the features would cause a temporary localized reduction in dissolved oxygen. All features are considered consistent with this guideline to the maximum extent practicable.

G.7.43. Guideline 6.12 - The weirs at the inlets and outlets of management units would create underwater obstructions. However, the beneficial impacts of the units should far outweigh the inconvenience caused by the obstruction.

G.7.44. Guideline 7.1 - Channel training above Morgan City, sediment reduction, and management units would reduce the amount of sediment deposited in swamps, and bottomland hardwood and forests would increase the amount of sediment available for delta development and marsh nourishment. The outlet control weir would slightly reduce the amount of sediment passing from Wax Lake Outlet but would not change the total amount reaching Atchafalaya Bay. All features are considered consistent with this guideline to the maximum extent practicable.

G.7.45. Guideline 7.3 - The channel training works would shunt sediment down the Lower Atchafalaya River and slightly increase the amount of sediment in the Chene, Boeuf, and Black navigation channel. The beneficial flood control impacts of training works and environmental impacts of the training above Morgan City outweigh this; therefore, these features are considered to be consistent with this guideline to the maximum extent practicable.

G.7.46. Guideline 7.5 - The water management plans associated with management units would benefit aquatic productivity but would decrease terrestrial productivity (see Section 6 of EIS). This feature is consistent with this guideline to the maximum extent practicable.

G.7.47. In general, most features are consistent with these guidelines. The channel training works below Morgan City are in questionable compliance with guidelines 1.7a, 1.7e, 1.7i, 1.7j, 1.7s, 3.1, 3.6, and 3.9. Prior to selection of the final plans, a more detailed trade-off analysis will be conducted to determine if environmental and economic benefits of the channel training are worth the environmental impacts that they would cause. At present, it appers that this channel training is the most feasible and practicable method to reduce the flowline. Thus, this feature is considered to be minimally consistent with these guidelines to the maximum extent practicable.

Section 8 - MARSH ACREAGE CALCULATIONS WITH AND WITHOUT PROJECT

INTRODUCTION

G.8.1. The future without-project marsh acreage calculations and estimates of marsh loss that would be caused by the Avoca Island levee extension that were utilized in the draft EIS were generally those presented by the US Fish and Wildlife Service in their Planning Aid Report. Their calculations were based on preliminary data from Wicker (1980) and Bauman and Adams (1981). Because of a change in the length of levee reaches recommended subsequent to their report and because the impacts of Reach 1 alone had never been calculated, the Corps made some independent calculations for the draft EIS based on the US Fish and Wildlife methodology. In the months since publication of the draft EIS, some preliminary raw data from Wicker became available and we have utilized this data to recalculate marsh loss with and without the project.

FUTURE WITHOUT-PROJECT

G.8.2. A basic assumption in estimating the future without-project marsh loss was that sediment transport to the western Terrebonne Parish marshes would be reduced naturally as the delta developed in Atchafalaya Bay. The mouths of numerous distributaries such as Deer Island, Plumb, Palmetto and Carencro Bayous would become progressively reduced in cross-section so the bayous would carry less and less sediment into the marshes.

G.8.3. Fresh marsh. The fresh marsh in Hydrologic Unit V was divided into two areas based on loss rates calculated from Wicker's data. The western fresh zone receives sediment directly from the Atchafalaya River via the numerous bayous that transect it and via overbank flow. Wicker's data shows marsh loss rates varying from -0.30 to -0.60 percent per year during the period 1956-1978. However,

Bauman and Adams showed that the area covered by Plumb Bayou and Carencro Bayou quadrangles had actually gained land in the 1972-1978 period. Thus, the assumption was made that the present loss rate for the former quad area would be -0.20 percent per year and not -0.30 percent per year as indicated by Wicker's data alone. The loss rate in the latter quad area was accordingly reduced from Wicker's -0.60 percent per year to -0.45 percent per year. The present marsh loss rate in the entire western zone was determined by estimating what percentage each quad contributed to the total zone and then multiplying that percentage by the annual loss in that quad and then adding the totals as shown below.

Morgan City SW	21 percent of area x 0.26 percent loss	= 0.005
Plumb Bayou	34 percent of area x 0.20 percent loss	= 0.068
Carencro Bayou	45 percent of area x 0.45 percent loss	= 0.203

Loss rate in entire zone = 0.326 percent per year

The eastern zone consists of the remainder of the fresh marsh area and receives little sediment input; thus, present loss rates vary from -0.40 percent per year to -1.35 percent per year. The present loss rate in the total eastern zone was calculated in the manner described above and was determined to be -0.96 percent per year.

G.8.4. The approximation was made that Atchafalaya Bay would be filled by the developing delta by sometime between 2010 and 2020. Rough assumptions of delta growth by decade were postulated. By approximately the year 2000, the western fresh marsh zone could be receiving a vastly reduced amount of sediment via distributary flow. Thus, one could assume that loss in the Plumb and Carencro Bayou quads could revert to that shown by Wicker's figures: -0.3 percent per year and -0.6 percent per year, respectively. When the loss in the total western zone is calculated using these figures the rate rises from the present -0.33 percent to -0.43 percent per year. As ensuing years pass, it was assumed that distributary flows would be reduced even more and western zone loss rates were assumed to increase by -0.10 percent each decade. By the 2020-2030 decade the loss rate was estimated to be -0.63 percent per year. The eastern zone was assumed to be unaffected by the developing delta and its loss rate was assumed to stay constant at -0.96 percent per yer.

G.8.5. The fresh marsh in Hydrologic Unit VI was calculated to have a loss rate of -0.48 percent at the present. As the percentage of flows going out the Wax Lake Outlet increased over the next 50 years, it was assumed that more sediment would be delivered to the Lake Salve quad and that between 2010 and 2030 the loss rate in Unit VI would decrease to -0.42 percent per year.

G.8.6. The only available data in Hydrologic Unit VII was for the Belle Isle quad which showed a loss rate of -0.02 percent per year.

The Belle Isle area received direct overflow from the Wax Lake Outlet while the remainder of the unit lies west of the Bayou Sale ridge. Over the next 50 years the loss rate in the Belle Isle quad would probably decrease while that of the western portion would increase slightly. Thus, it was assumed that the -0.02 percent per year loss rate would apply for the entire Unit from 1980 to 2030.

G.8.7. Table G-8-1 shows the estimated loss rate and the acreage in each marsh zone by hydrologic unit and by decade. During the period from 1980 to 2000, an unquantifiable amount of brackish marsh in the area covered by the Four League Bay and Plumb Bayou quads could become fresh as the freshwater bulb moves eastward. However, once the mouth of Four League Bay became constricted, this marsh could revert to brackish. Between 2000 and 2030 an unquantifiable amount of fresh marsh could become brackish as the percentage of flows between the Wax Lake Outlet and the Lower Atchafalaya River stabilizes at 50/50. Also, as subsidence occurs in the eastern zone, an unknown amount could become brackish. Because of the uncertainty of occurrence, none of these possibilities were considered in formulating Table G-8-1.

G.8.8. Brackish marsh. Brackish marshes were divided into a western zone that receives sediment via distributary flow and overbank flow from the Atchafalaya River and an eastern zone that is unaffected by the river. The marsh loss rate in the western zone was calculated to be -0.37 percent per year. Bauman and Adams found that the Four League Bay quad area gained in land between 1972 and 1978. Thus, it was assumed that the -0.42 percent annual loss calculated from Wicker's data for 1956-1978 would be reduced to -0.25 percent at the present. By approximately 2000, the sediment flows into Four League Bay could be reduced and the loss rate in the western zone could increase to -0.50 percent per year from 2000 to 2010. If it were assumed this loss rate would continue to increase as sediments transport decreased, the 2010-2030 loss rate would be -0.61 percent per year. It was assumed that the present rate in the eastern zone, -0.95 percent per year, would remain the same from 1980 to 2030. See Table G-8-1 for acreages. In the eastern zone, an unquantifiable amount of brackish marsh could become saline as subsidence increases. In the western zone, an unknown amount of saline marsh could become brackish during the next 25 years, but would revert to saline eventually.

G.8.9. Saline marsh. The western zone includes the area covered by the Oyster Bayou and East Bay Junop quads which are near the gulf. The marsh receives some sediment nourishment due to river and tidal transport. The overall loss rate is -0.43 percent per year. The eastern zone has a larger percentage of its area removed from the gulf and river influence and the loss rate is -1.11 percent per year. Since the delta would have little influence on the saline zone, it was assumed that these loss rates would remain the same for the 1980-2030 period. Thus, it was possible to calculate the loss rate for the entire saline zone to be -0.87 percent per year.

TABLE G-8-1

MARSH LOSS RATE AND ACREAGE BY DECADE FOR THE FUTURE WITHOUT-PROJECT CONDITION

	UNIT V										UNIT VI		UNIT VII	
	Western Fresh		Eastern Fresh		Western Brackish		Eastern Brackish		Saline		Fresh		Fresh	
Years	loss[1/] rate	acres	loss rate	acres	loss rate	acres	loss rate	acres	loss rate	acres	loss rate	acres	loss rate	acres
1980	0.33	96,033	0.96	126,822	0.37	57,216	0.95	31,810	0.87	107,337	0.48	47,992	0.02	50,581
1990	0.33	92,911	0.96	115,160	0.37	55,134	0.95	28,914	0.87	98,356	0.48	45,737	0.02	50,480
2000	0.43	89,890	0.96	104,570	0.50	53,128	0.95	26,282	0.87	90,126	0.48	43,589	0.02	50,379
2010	0.53	86,099	0.96	94,954	0.61	50,531	0.95	23,889	0.87	82,585	0.42	41,541	0.02	50,278
2020	0.63	81,643	0.96	86,223	0.61	47,532	0.95	21,714	0.87	75,675	0.42	39,829	0.02	50,178
2030	-	76,643	-	78,293	-	44,711	-	19,737	-	69,343	-	38,187	-	50,077

[1/] Loss rate in percent per year. This rate applies to subsequent decade.

G.8.10. Nonmarsh habitats. By utilizing Wicker's raw data sheets and overlaying the 1956 and 1978 US Fish and Wildlife Service habitat maps, it is possible to calculate not only marsh loss by quadrangle, but to estimate what habitat type these marsh acres became. Then one could take the weighted percentage loss per year by quad and calculate what percentage that is of the total zone loss. This percentage, when multiplied by the acres lost by zone per decade, gives the acres lost per quad area by decade. The percentage of the lost marsh by quad area that each nonmarsh habitat type gains is calculated next. This percentage is applied to the marsh loss by quad and the acreage increase in nonmarsh habitat types by decade is the result (see Table G-8-2).

IMPACTS OF THE AVOCA ISLAND LEVEE EXTENSION

G.8.11. As discussed in the Main Report/EIS, no recommendation will be made at this time for implementing the Avoca Island levee extension. However, the first reach of the levee extension was left in the NED plan because it would be the least costly method of flood protection. Thus, it was necessary to calculate the impacts of Reach 1 and to also calculate the impacts of the entire channel alinement levee extension. The latter was necessary because we have no accurate way to compare plans if we do not assume that continued levee extension would prevent rising water levels in the backwater area.

G.8.12. Fresh marsh. The eastern fresh marsh and marshes in Hydrologic Units VI and VII would not be affected by the levee extension. In the western zone, Reach 1 would not block Deer Island Bayou, and the Avoca Island Cutoff would still exist, though lengthened. The water diversion structure would introduce some sediment into the area covered by the Morgan City SW quad, but overall sediment transport would be reduced. Sheet flow to the Plumb Bayou quad area would be decreased and thus the loss rate in this western zone could rise from the present -0.35 percent to -0.36 percent per year in 1988 when Reach 1 would be built. If one makes the assumption that only Reach 1 would be built, then the loss due to this reach alone can be somewhat inaccurately calculated by assuming that after 2000 the loss rates in the western fresh zone would be similar to future without-project conditions. If one does this, the fresh marsh loss caused by Reach 1 alone would be approximately 900 acres. In order to accurately compare plans one must assume the entire levee would be built. Reach 2 in 1993 could further reduce sediment transport because the levee would block Deer Island Bayou and part of Crooked Bayou. Thus, the loss rate in the western zone could increase to -0.43 percent per year for the 1993-2000 period. Reach 3 in 2003 would nearly completely remove the western zone from distributary flows and the loss rate could increase to -0.56 percent per year from 2003 to 2010. Reach 4 in 2014 could slightly reduce sediment transport into

TABLE G-8-2

ACRES OF MARSH LOST AND NONMARSH HABITAT GAINED FOR THE FUTURE WITHOUT PROJECT CONDITION

Decade and Marsh Type	Marsh Acres Lost	ACRES OF NEW HABITAT CREATED								
		Lakes	Bayous	Spoil	Shrub	Cypress-Tupelo	Open Land	Riverine	Mangrove	Other
1980-1990										
Fresh	17,240	12,120	1,029	1,287	1,041	890	419	235		119
Brackish	4,978	4,138	348	228	111	60			35	52
Saline	8,981	8,162	302	280	81	60			94	
1990-2000										
Fresh	15,860	11,121	972	1,217	965	849	399	226		111
Brackish	4,638	3,851	331	215	102	55			34	50
Saline	8,230	7,482	275	256	76	66			86	
2000-2010										
Fresh	15,556	10,703	1,086	1,309	935	825	380	200		116
Brackish	4,990	4,069	281	267	88	56			45	53
Saline	7,580	6,889	385	236	70	51			79	
2010-2020										
Fresh	14,999	10,233	1,176	1,368	876	709	318	200		117
Brackish	5,174	4,180	455	284	79	53			53	61
Saline	6,910	6,278	231	215	64	46			72	
2020-2030										
Fresh	14,673	9,805	1,277	1,435	839	692	305	200		120
Brackish	4,786	3,871	425	265	72	49			47	57
Saline	6,330	5,754	212	197	59	42			66	

the western fresh zone and the loss rate could increase to -0.63 percent per year as this zone becomes further from the sediment source. Reaches 5 and 6 would probably only slightly reduce loss rates in the fresh zone to -0.69 percent per year. Table G-8-3 shows loss rates and acreage by target years. It was assumed that enough freshwater would be transported across the levee to maintain future without-project isohalines.

G.8.13. Brackish marsh. Loss rates in the eastern zone would be unaffected by the levee extension. Until completion of Reach 3 in 2003, loss rates in the western zone would be similar to those without the project. Reach 3 would prevent some sediment from reaching this zone and the loss rate would increase to -0.52 percent per year until 2010 when there would be a loss increase similar to that in the future without-project condition and the rate would be -0.63 percent per year until 2014. Reach 4 in that year would further decrease flows to Four League Bay and increase the loss rate to -0.73 percent per year. Reach 5 in 2024 would similarly increase the loss rate to -0.84 percent per year by reducing sediment transport into this zone.

G.8.14. Saline marsh. Saline marsh would be unaffected by the levee extension until construction of Reach 4 in 2014 slightly reduced the sediment transport through Four League Bay which would increase the loss rate to -0.88 percent per year. Reaches 5 and 6 would increase the loss rate to -0.89 percent per year.

G.8.15. Delta. In order to calculate the impacts of the levee extension on the delta it was assumed that there were approximately 30,000 acres of delta that would be east of the levee; 1,500 acres behind Reach 3; 7,000 behind Reach 4, 7,600 behind Reach 5 and 14,600 behind Reach 6. Then it was assumed that this delta would have an initial loss rate slightly higher than that of fresh marsh under the influence of the river or approximately 0.5 percent per year. However, as the levee became extended further, the marsh loss rate behind the previous reach was assumed to double to -1 percent per year and would double again with the next reach to -2 percent per year. This effect would occur because the sediments would be further removed from the delta in question and the rate of compaction and subsidence in newly formed delta is very high. Table G-8-4 compares the acres of delta without the levee extension and those with the extension. In this case the analysis was carried out to 2080 because the most significant losses occur between 2030 and 2080 as the isolated delta deteriorates.

G.8.16. Nonmarsh. Gains in nonmarsh habitat types due to construction of the levee extension were calculated in a manner similar to that described in paragraph G.8.10.

TABLE G-8-3

HYDROLOGIC UNIT V MARSH LOSS RATE AND ACREAGE BY TARGET YEAR FOR THE CHANNEL ALINEMENT OF THE AVOCA ISLAND LEVEE EXTENSION

Target Year	Marsh Type					
	Western Fresh		Western Brackish		Saline	
	loss rate	acres	loss rate	acres	loss rate	acres
1980	0.33	96,033	0.37	57,216	0.87	107,337
1988	0.36	93,527	0.37	55,544	0.87	100,090
1993	0.43	91,165	0.37	54,524	0.87	95,811
2000	0.47	87,726	0.50	53,128	0.87	90,126
2003	0.56	86,495	0.52	52,335	0.87	87,794
2010	0.59	83,161	0.63	50,459	0.87	82,585
2014	0.63	81,216	0.73	49,199	0.88	79,749
2020	0.67	78,194	0.73	47,083	0.88	75,630
2024	0.69	76,119	0.84	45,723	0.89	73,003
2030	-	73,022	-	43,466	-	69,190

1/ Loss rate is percent per year until subsequent target year.

TABLE G-8-4

LOSS OF DELTA DUE TO THE AVOCA ISLAND LEVEE EXTENSION

Year	Acres of Delta Without-Project	Acres of Delta with Levee Extension
1980	10,100	10,100
1990	35,000	35,000
2000	59,900	59,900
2010	84,900	84,094
2020	110,000	108,103
2030	135,000	130,656
2080	135,000	113,728

G.8.17. Summary. When the estimated number of acres in 2030 with construction of entire Avoca Island levee extension are compared to number of acres that would exist under future without-project conditions, the following results are noted:

Fresh marsh:	-3,620 acres
Brackish marsh:	-1,245 acres
Saline marsh:	-150 acres
Delta:	-4,350 acres (an additional 17,000 acres would be lost by 2080)

It must be remembered that these calculations are only approximate and that the Avoca Island levee extension is not part of the recommended plan. During the next 4 years sediment transport and circulation patterns in the area would be studied and if the Avoca Island levee extension were recommended, the following impact assessment in the supplemental EIS would be far more precise than the above estimate.

Section 9 - TABLES OF INTEREST

G.9.1. Various tables of interest are included in this section. Table G-9-1 is the "National Audubon Society Blue List for 1979". Table G-9-2 is "Common and Scientific Names of Plants Referenced in this Report and Appendixes". Tables G-9-3 through G-9-13 show direct construction impacts of levee raising, by reach, for plans studied in detail.

TABLE G-9-1

NATIONAL AUDUBON SOCIETY "BLUE LIST" FOR 1979

Red-necked grebe	*Gull-billed tern
Western grebe	Least tern
*White pelican	*Black tern
*Double-crested cormorant	*Roseate tern
*Reddish egret	Common puffin
*Black-crowned night heron	*Yellow-billed cuckoo
*Least bittern	*Black-billed cuckoo
*American bittern	*Barn owl
*Wood Stork	*Burrowing owl
*White-faced ibis	*Short-eared owl
*Fulvous whistling duck	*Common nighthawk
*Canvasback	*Ruby-throated hummingbird
*Sharp-shinned hawk	*Red-headed woodpecker
*Cooper's hawk	Lewis' woodpecker
*Red shouldered hawk	*Hairy woodpecker
Swainson's hawk	*Purple martin
Ferruginous hawk	*Bewick's wren
Harris hawk	*Short-billed marsh wren
*Marsh hawk	Florida scrub jay
*Osprey	*Eastern bluebird
Caracara	Western bluebird
Prairie falcon	Mountain bluebird
*Merline	*Loggerhead shrike
*American kestrel	*Bell's vireo
Sharp-tailed grouse	*Warbling vireo
Sage grouse	*Yellow warbler
*King rail	*Yellow-breasted chat
*American oystercatcher	*Dickcissel
*Piping plover	*Grasshopper sparrow
*Snowy plover	*Henslow's sparrow
*Upland sandpiper	*Vesper sparrow
*Common tern	*Backman's sparrow

*Range includes project area.

TABLE G-9-2

COMMON AND SCIENTIFIC NAMES OF PLANTS REFERENCED
IN THE REPORT AND APPENDIXES
(Arranged Alphabetically by Common Name)

COMMON NAME	SCIENTIFIC NAME
Alligatorweed	*Alternanthera philoxeroides*
American elm	*Ulmus americana*
Arrowhead	*Sagittaria* sp.
Ash	*Fraxinus* sp.
Aster	*Aster* sp.
Bahia grass	*Paspalum notatum*
Beggar's ticks	*Bidens* sp.
Bermuda grass	*Cynodon dactylon*
Bitter pecan	*Carya aquatica*
Blackberry	*Rubus* sp.
Black rush	*Juncus roemarianus*
Black willow	*Salix nigra*
Bluegrass	*Poa* sp.
Boxelder	*Acer negundo*
Broomsedge	*Andropogon virginicus*
Bulltongue	*Sagittaria falcata*
Butterweed	*Senecio glabellus*
Cattail	*Typha* sp.
Chinese tallow tree	*Sapium sebiferum*
Cockelbur	*Xanthium* sp.
Common ragweed	*Ambrosia artemisiifolia*
Coontail	*Ceratophyllum demersum*
Cottonwood	*Populus deltoides*
Cyperus	*Cyperus* sp.
Cypress	*Taxodium distichum*
Dallis grass	*Paspalum dilatatum*
Deciduous holly	*Ilex decidua*
Deer pea	*Vigna repens*
Dewberry	*Rubus* sp.
Drummond red maple	*Acer rubrum* var. *drummondii*
Duckweed	*Lemna minor*
Eastern baccharis	*Baccharis halimifolia*
Elderberry	*Sambucus canadensis*
Elephant's foot	*Elephantopus* sp.
Eurasian watermilfoil	*Myriophyllum spicatum*
Falsenettle	*Boehmeria cylindrica*
Fanwort	*Cabomba caroliniana*
Feather fingergrass	*Chloris* sp.
Goldenrod	*Salidago* sp.
Green ash	*Fraxinus pennsylvanica*
Greenbriar	*Smilax* sp.
Hackberry	*Celtis laevigata*

TABLE G-9-2
(Continued)

COMMON NAME	SCIENTIFIC NAME
Hawthorn	Crataegus sp.
Hog cane	Spartina cynosuroides
Horsetail	Equisitum sp.
Johnson grass	Sorghum halepense
Ladies eardrops	Brunnichia cirrhosa
Leadplant	Amorpha fruticosa
Live oak	Quercus virginiana
Lizard's tail	Saururus cernuus
Marsh elder	Iva fruteseens
Maidencane	Panicum hemitomon
Naiad	Najas sp.
Nuttal oak	Quercus nuttallii
Oak forest grass	Oplismenus setarius
Overcup oak	Quercus lyrata
Oystergrass	Spartina alterniflora
Palmetto	Sabal minor
Pennywort	Obolaria virginica
Peppervine	Ampelopsis arborea
Pondweed	Potamogeton
Poison ivy	Rhus sp.
Pumpkin ash	Fraxinus tomentosa
Rattan vine	Berchemia scandens
Roughleaf dogwood	Cornus drummondii
St. Johnswart	Hypericum sp.
Sandbar willow	Salix interior
Saltgrass	Distichlis spicata
Santa Maria	Parthenium hysterophorus
Sea-purslane	Sesuvium sp.
Shield fern	Thelypteris normalis
Shoal grass	Halodule beaudettei
Smartweed	Polygonum sp.
Smut grass	Sporobolus poiretii
Snowbell	Styrax sp.
Soft rush	Juncus effusus
Spiderlily	Hymenocallis occidentalis
Spikerush	Eleocharis sp.
Swamp privet	Forestiera acuminata
Sweetgum	Liquidambar styraeiflua
Sycamore	Platanus occidentalis
Three-cornered grass	Scirpus olneyi
Thoroughwort	Eupatorium sp.
Trumpet creeper	Campsis radicans
Turtle grass	Thalassia testudinum
Tupelo	Nyssa aquatica
Vasey grass	Paspalum urvillei

TABLE G-9-2
(Continued)

COMMON NAME	SCIENTIFIC NAME
Virginia creeper	Parthenaciscus quinquefolia
Water elm	Planera aquatica
Water hyacinth	Eichornia crassipes
Watermeal	Wolffia sp.
Water oak	Quercus nigra
Water willow	Justicia sp.
Waxmyrtle	Myrica cerifera
Widgeon grass	Ruppia maritima sp.
Wildcelery	Vallisneria americana
Willow	Salix sp.
Willow oak	Quercus phellos
Winter grass	Stipa sp.
Wiregrass	Spartina patens
Yankeeweed	Eupatorium capillifolium

TABLE G-9-3

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 2 FWO
(Acres)

Levee Reach	ESBLHW[1] From	ESBLHW[1] to	Open From	Open to	LSBLHW[2] From	LSBLHW[2] to	CT[3] From	CT[3] to	Water From	Water to
	Open	Borrow	Open	Borrow	Open	Borrow	Open	Borrow	Open	Borrow
1395-1805			40	22	8					
W40	37		351	139	38	298			5	
W46-W49			300	136	121	458			17	51
W52-W49			260	202	72	197		74	13	116
W58			187	169		167			8	
W61			150	107	38	214			10	17
W64			120		163	501			36	86
W68			237			551		132	32	
W74	139	10	138					118		77
W78	150	396	200	92						10
W85		223	216					290		50
W86		68	30					70		
W91	70		100	20		102		84	65	
W95	87	21	136	125				100	80	
W99	53		30	60			28	245	38	25
W102			115	10			36	484	14	
W106			116	40		60		144	13	33
W112			120			128			30	
W117	20	30	174	180		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	556	748	3,109	1,308	440	2,696	84	1,909	369	471

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-4

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 4 EQ
(Acres)

Levee Reach	ESBLHW[1] From Open	ESBLHW[1] to Borrow	Open From Open	Open to Borrow	LSBLHW[2] From Open	LSBLHW[2] to Borrow	CT[3] From Open	CT[3] to Borrow	Water From Open	Water to Borrow
1395-1805			40	21	8					
W40	37		351	129	38	284				
W46-W49			300	136	121	458			17	51
W52-W49			260	137	53	141		54		96
W58			157	71		114				
W61			130	106	4	162				17
W64			120		140	356			16	60
W68			223			416		105	16	
W74	139	10	138					118		77
W78	109	244	200	92						10
W85		147	186					164		24
W86		68	30					70		
W91	45		100	20		102		84	40	
W95	28	21	136	125				100	27	
W99	46		30	60			25	245	26	25
W102			115	10			30	419	7	
W106			116	40		36		96	13	33
W112			120			80			30	
W117	20	30	174	142		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	424	520	3,015	1,095	364	2,169	75	1,623	200	399

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-5

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 7 NED
(Acres)

Levee Reach	From ESBLHW[1/] to Open	to Borrow	From Open to Open	to Borrow	From LSBLHW[2/] to Open	to Borrow	From CT[3/] to Open	to Borrow	From Water to Open	to Borrow
1395-1805			40	21	8					
W40	34		351	80	35	270				
W46-W49			300	131	118	445			13	51
W52-W49			260	137	50	141		54		96
W58			154	53		104				
W61			140	30		71				17
W64			120		135	331			11	55
W68			218			397		97	10	
W74	139	10	138					118		77
W78	109	244	200	92						10
W85		147	186					164		24
W86		68	30					70		
W91	45		100	20		102		84	40	
W95	28	21	136	125				100	27	
W99	46		30	60			25	245	26	25
W102			115	10			30	400	7	
W106			116	40		36		96	13	
W112			120			80			30	
W117	20	30	174	142		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	421	520	3,017	947	346	1,997	75	1,596	185	361

[1/] Early successional bottomland hardwoos

[2/] Mid-to-late successional bottomland hardwoods

[3/] Cypress-tupelo

TABLE G-9-6

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 9 RECOMMENDED
(Acres)

Levee Reach	From ESBLHW[1/] to Open	ESBLHW[1/] to Borrow	From Open to Open	Open to Borrow	From LSBLHW[2/] to Open	LSBLHW[2/] to Borrow	From CT[3/] to Open	CT[3/] to Borrow	From Water to Open	Water to Borrow
1395-1805			40	20	8					
W40	32		351	91	32	251				
W46-W49			300	131	118	445			13	51
W52-W49			260	135	46	142		52		95
W58			155	59		107				
W61			151	52		106				17
W64			120		137	340			13	57
W68			218			397		97	10	
W74	139	10	138					118		77
W78	109	244	200	92						10
W85		147	186					164		24
W86		68	30					70		
W91	45		100	20		102		84	40	
W95	28	21	136	125				100	27	
W99	46		30	60			25	245	26	25
W102			115	10			30	436	7	
W106			116	40		36		96	13	
W112			120			80			30	
W117	20	30	174	142		20	20	88	8	
W121			64	6				80		6
W123			9							
W124			16							
TOTAL	419	520	3,029	983	341	2,026	75	1,630	187	362

[1/] Early successional bottomland hardwoods

[2/] Mid-to-late successional bottomland hardwoods

[3/] Cypress-tupelo

TABLE G-9-7

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 2 FWO
(Acres)

Levee Reach	From ESBLHW[1] to Open	to Borrow	From Open to Open	to Borrow	From LSBLHW[2] to Open	to Borrow	From CT[3] to Borrow	From Water to Open	to Borrow	From BLHW/CT to Borrow
E14			112	124		92				
E16			127	185	60	179		30		
E22			100	169	46	195		21		
E28			86	10	60	371		21		
E33			111		54	586		119		
E36			181		50	564		131		
E40	63	214	203	30		197		4		
E44	178		312			573		38	17	
E50 & E52	112		111			370		102	26	
E54	26		56			112		5		
E58	47		138			272		5		
E61	8		60			16		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			40		20		20
E73	30		133	8		130	67	71	33	
E74	5		47			220	32	23	10	
E75	4		24					2		
E76	15		56				25	14	30	
E77	50		108				50	13	50	
E84	10		65				144			
E85		2	21							
E87			106				43			
E89			100							12
TOTAL	595	225	2,345	526	310	4,140	361	668	166	32
Avoca Island	43		261		10	Minor impacts only - I wall				

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-8
DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 4 EQ
(Acres)

Levee Reach	From Open to	ESBLHW[2] Borrow	From Open to	Borrow	From LSBLHW[2] Open to	Borrow	From CT[3] to Borrow	From Water Open to	Borrow	From BLHW/CT to Borrow
E14			112	105		76				
E16			127	126	60	80				
E22			100	83	32	119				
E28			86		60	226				
E33			111		42	442		114		
E36			181		40	546		121		
E40	63	214	151	7		72		2		
E44	178		312			419			17	
E50 & E52	112		111			280		66	26	
E54	21		56			57		4		
E58	40		124			108		3		
E61	8		60			16		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			48			20	20
E73	30		133	8		82	67	58	33	
E74	5	47				96	22	20	10	
E75	4	24						2		
E76	10		56				25	14	30	
E77	50		108				50	13	50	
E84	10	2	65				144			
E85			21							
E87			106				43			
E89			100							12
TOTAL	578	225	2,339	329	274	2,890	351	466	186	32
Avoca Island	43		261		10	Minor impacts only - I wall				

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-9

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 7 NED
(Acres)

Levee Reach	From ESBLHW[1/] to Open	to Borrow	From Open to Open	to Borrow	From LSBLHW[2/] to Open	to Borrow	From CT[3/] to Borrow	From Water to Open	to Borrow	From BLHW/CT to Borrow
E14			95	44		32				
E16			127	126	60	80				
E22			100	69	32	117				
E28			86		46	202				
E33			111		38	442		111		
E36			181		40	534		121		
E40	63	214	125	7				2		
E44	153		312			323			17	
E50 & E52	112		111			250			26	
E54	20		56			40		3		
E58	40		124			108		3		
E61	8		60			61		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			40			20	20
E73	30		133	8		70	67	58	33	
E74	5		47			156	22	20	10	
E75	4		24					2		
E76	15		56				25	14	30	
E77	50		108				50	13	50	
E84	10		65				144			
E85		2	21							
E87			106				43			12
E89			100							
TOTAL	557	225	2,296	254	256	2,678	351	396	186	32
Avoca Island	43		261		10	Minor impacts only - I wall				

[1/] Early successional bottomland hardwoods

[2/] Mid-to-late successional bottomland hardwoods

[3/] Cypress-tupelo

TABLE G-9-10

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
PLAN 9 RECOMMENDED
(Acres)

Levee Reach	From ESBLHW[1] to Open	to Borrow	From Open to Open	to Borrow	From LSBLHW[2] to Open	to Borrow	From CT[3] to Borrow	From Water to Open	to Borrow	From BLHW/CT to Borrow
E14			95	44		32				
E16			127	126	60	80				
E22			100	66	32	112				
E28			86		46	226				
E33			111		42	442		114		
E36			181		40	534		121		
E40	63	214	51	7		72		2		
E44	128		312			419			17	
E50 & E52	112		111			250			26	
E54	20		56			40		3		
E58	40		124			108		3		
E61	8		60			61		5		
E64	40		80		40	223		44		
E68 & E69	7	9	68			40			20	20
E73	30		133	8		82	67	58	33	
E74	5		47			158	22	20	10	
E75	4		24					2		
E76	15		56				25	14	30	
E77	50		108				50	13	50	
E84	10		65				144			
E85		2	21							
E87			106				43			
E89			100							12
TOTAL	532	225	2,222	251	260	2,879	351	399	186	32
Avoca Island	43		261		10	Minor impacts only - I wall				

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-11

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST OF BERWICK
PLAN 2 FWO
(Acres)

	From Open	ESBLHW[1] to Borrow	From Open	Open to Borrow	From Open	LSBLHW[2] to Borrow	From Open	CT[3] to Borrow	From Open	Water to Borrow	From Open	Fresh Marsh to Borrow
Wax Lake East	60	174	100		50	307		38		40		151
Wax Lake East Outlet		10	48	8	24	2						
Wax Lake West Outlet			43		87	39						
Wax Lake West			35	10	15	95						
East Bayou Sale			48	20			47	132				
West Bayou Sale A			43	28			22	86				
West Bayou Sale B			43	38			21	76			21	38
Teche Ridge 1			30	10	8	10		45				
Teche Ridge 2 & 3			18	2	8	10		30				
TOTAL	60	184	408	116	192	463	90	407		40	21	189
					PLAN 4 EQ							
Wax Lake East	98	204	100		90	422		44	6	50		165
Wax Lake East Outlet		10	55	19	27	4						
East Bayou Sale			50	55			85	324	33			
West Bayou Sale A			75	78			37	231	26			
West Bayou Sale B			64	81			32	162	45		32	81
Teche Ridge 1			30	25	8	20	6	105	7			
Teche Ridge 2 & 3			18	7	8	42		121	7			
TOTAL	98	214	392	265	133	488	160	987	124	50	32	246

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-12

DIRECT CONSTRUCTION IMPACTS OF RAISING LEVEES
WEST OF BERWICK
PLAN 7 NED
(Acres)

	From ESBLHW[1] to Open	ESBLHW[1] to Borrow	From Open to Open	Open to Borrow	From LSBLHW[2] to Open	LSBLHW[2] to Borrow	From CT[3] to Open	CT[3] to Borrow	From Water to Open	Water to Borrow	From Fresh Marsh to Open	Fresh Marsh to Borrow
Wax Lake East	126	215	100		100	430		48	8	54		56
Wax Lake East Outlet		10	55	18	27	4						
East Bayou Sale			50	98			124	349	33			
West Bayou Sale A			99	98			49	294	26			
West Bayou Sale B			88	96			44	194	45		45	96
Teche Ridge 1			30	30	8	25	8	45	9			
Teche Ridge 2 & 3			18	9	8	53		154	13			
TOTAL	126	225	440	349	143	512	225	1,084	134	54	45	152
						PLAN 9 R						
Wax Lake East	126	218	100		100	345		48	9	54		185
Wax Lake East Outlet		10	55	20	27	4						
East Bayou Sale			50	98			124	349	33			
West Bayou Sale A			99	98			49	294	26			
West Bayou Sale B			88	96			45	193	45		45	96
Teche Ridge 1			30	3	8	25	8	129	9			
Teche Ridge 2 & 3			18	9	8	53		154	13			
TOTAL	126	218	440	324	143	427	226	1,167	135	54	45	281

[1] Early successional bottomland hardwoods

[2] Mid-to-late successional bottomland hardwoods

[3] Cypress-tupelo

TABLE G-9-13

DIRECT CONSTRUCTION IMPACTS
ATCHAFALAYA RIVER LEVEES AND MORGANZA LEVEE
(Acres)

	From ESBLHW[1/] to Levee	ESBLHW[1/] to Borrow	From Open to Levee	Open to Borrow	From LSBLHW[2/] to Levee	LSBLHW[2/] to Borrow
WEST ATCHAFALAYA RIVER LEVEE						
Plan 2 FWO	2	270	30	30	0	0
Plan 4 EQ	2	180	400	30	0	0
Plan 7 NED	2	160	390	30	0	0
Plan 9 TSP	2	160	390	30	0	0
EAST ATCHAFALAYA RIVER LEVEE						
Plan 2 FWO	0	10	10	20	10	0
Plan 4 EQ	0	10	10	20	10	0
Plan 7 NED	0	10	10	10	10	0
Plan 9 TSP	0	10	10	10	10	0
MORGANZA LEVEE						
Plan 2 FWO	0	0	-	0	0	-
Plan 4 EQ	0	0	60	0	0	10
Plan 7 NED	0	0	60	0	0	10
Plan 9 TSP	0	0	60	0	0	10

[1/] Early successional bottomland hardwoods.

[2/] Mid-to-late successional bottomland hardwoods.

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Section 11 - 404(b)(1) EVALUATIONS

G.11.1 The provisions of Section 404 of the Clean Water Act for all project features except levees, floodwalls and bank stabilization will be met via the Section 404(r) process by the submission of this EIS, including a Section 404(b)(1) Evaluation, to Congress for appropriation and/or authorization action. The levees, floodwalls, and bank stabilization features will meet Section 404 provisions by preparation of a Section 404(b)(1) Evaluation. A Public Notice will be prepared and a Water Quality Certificate will be requested from the State of Louisiana for these three features. This course is necessary because items of these three authorized features are scheduled for construction in the near future and the Section 404(r) exemption process is too lengthy to complete prior to construction on these items. Certain other features are also authorized. If it is deemed necessary to construct any of these features prior to completion of the Section 404(r) process, the Public Notice/State Water Quality Certification process will be utilized.

G.11.2 The necessary project features comprising the Recommended Plan have been evaluated with respect to Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, published by the US Environmental Protection Agency on 24 December 1980. These evaluations are included in Appendix G of this report. Since the 404(b)(1) Evaluation for levees and floodwalls is not complete at this time and since those features will meet Section 404 provisions via a State of Louisiana Water Quality Certificate, this Evaluation is not included in Appendix G. Bank stabilization will also meet Section 404 provisions via the same route, but since the 404(b)(1) Evaluation is complete, the Evaluation is included in Appendix G. Separate evaluations have been written for each feature (at the informal request of the US EPA) except where features are clearly interrelated such as channel training above Morgan City with outlet flow distribution and management units with diversion structures. Some of these evaluations will be refined and updated when more site-specific water, sediment, and disposal area physical and/or chemical data become available.

G.11.3 The following synthetic hydrocarbons were sampled in the Atchafalaya Basin, and analyzed in 1981: aldin, chlordane, DDD, DDE, DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, lindane, PCB-1242, -1248, -1254, -1260, toxaphene, mirex, and methoxychlor. Results of those analyses are not shown on the tables because the minimum detection limits were generally well above current EPA criteria levels and definite conclusions as to release potentials could not be drawn.

Bank Stabilization

I. Introduction. A comprehensive plan for flood control in the Atchafalaya River was authorized by the Flood Control Act of 1928 under the Mississippi River and Tributaries Project (MR&T). The Act provided for the construction of a system of improvements to increase channel capacity, including revetments, dikes, dredging, and other features such as floodwalls, floodgates, cutoffs, and pumping plants, to enable the Lower Mississippi River System and its tributaries to pass the project design flood. A key feature of the project is the construction of revetment works to stabilize the river bank and protect the levee system which confines the Atchafalaya River channel.

A Public Notice was issued by the New Orleans District on 15 March 1976 to acquaint governmental agencies and the interested public with Corps of Engineers' intentions to construct a series of revetment works on the Atchafalaya River. A Statement of Findings, issued on 25 May 1976, summarized comments received on the Public Notice and concluded that the benefits associated with construction and maintenance of the revetments far outweighed the minor detrimental aspects. The US Environmental Protection Agency (USEPA), by letter dated 10 June 1976, concurred with the Corps' determination to proceed. Since that time, additional revetment works needed to stabilize caving and eroding banks have been identified to protect the levee system.

This evaluation is being prepared under Section 404 of the Clean Water Act of 1977 using guidelines promulgated by USEPA on 24 December 1980. These guidelines require that construction involving dredged or fill material taking place after 1 October 1981 be evaluated to determine: that no practical alternative exists which will have less adverse impact on the aquatic ecosystem; that appropriate State and Federal Water Quality Standards will not be violated; that the discharge will not contribute to significant degradation of waters of the United States; and that all possible steps have been taken to minimize potential adverse impacts on the aquatic ecosystem. Additionally, marine sanctuaries, endangered or threatened species, and critical habitat shall not be jeopardized.

II. Project Description.

a. Location. The project occupies portions of the Red and Atchafalaya Rivers' banks and channels from the Old River outflow channel to Atchafalaya River mile 55.0, and a 0.5 mile reach of the Atchafalaya River at river mile 115. Plate 1 is a general map of the area.

b. General Description. The project would consist of the construction of revetments at various locations along the river to retard bank erosion and protect the mainline levees. The plan would call for the construction of a total of 65 miles of revetment works at 41 sites along the river. Of this total, 41 miles have been constructed and 24 miles remain to be constructed. Table G-11-1 lists the revetments, location, construction completed and remaining construction. Plates 2 through 7 show the location of the revetment sites. Articulated concrete mattress (ACM) would be placed on graded banks from the low water line riverward. Exposed banks would be paved with stone. The project is scheduled for completion in the year 2000.

c. Authority and Purpose. The Flood Control Act of 1928, as amended by subsequent Acts of Congress, provides for channel improvement in the MR&T. The plan of improvements includes construction of revetments to stabilize the river banks and to protect mainline levees.

d. General Description of Dredged or Fill Material.

(1) General characteristics of material.

(a) Holocene soils are encountered along the Atchafalaya River bank in this section of the river. They include mainly alluvial deposits with some point bar deposits and interdistributary and deltaic plain sediments. Alluvial and point bar materials consist of silts and clays. Deltaic plain sediments are interfingered masses of silts and clays, while the interdistributary materials are comprised of clay wedges formed between major distributaries. Undifferentiated Pliocene-Miocene Series deposits underlie the Holocene materials in a narrow east-west band across the basin. Plate 8 shows the complex surface distribution pattern of these deposits through the construction area.

(b) The below-water portion of the revetment would be an ACM, placed as a continuous layer of concrete block from a specially designed floating plant. The mattress would extend from the low water line to approximately 50 feet beyond the deepest part of the river bed. The ACM would be made from precast concrete units (squares) each measuring 4 feet by 25 feet by 3 inches. The squares would be connected by wire imbedded in the concrete which would be looped through the square to form the mattress. Stone would be placed in a 10-inch layer from the shoreward edge of the concrete mattress to the top of the degraded bank. The stone would be of a hard, durable quality and would be reasonably well-graded between 6 and 125 pounds. Before placement of the mattress, an upper layer of shell or gravel would be placed from midway between the water line and the top of the degraded bank to 5 feet below the water for temporary erosion protection.

TABLE G-11-1

REVETMENTS

Location (River mile)		Revetment Name	Total	Amount (miles) Completed	Amount (miles) Uncompleted
9	R*	Long Lake	1.5	1.2	0.3
5	L*	Turnbull Island	2.0	1.3	0.7
2	R*	Naples	1.2	1.2	0.0
1	L	Mile One	0.8	0.8	0.0
2.5	R	Coville Bayou	1.6	1.2	0.4
4.0	L	Legonier	2.0	1.7	0.3
5.5	R	Simmesport	2.4	2.0	0.4
7.5	L	Kuhlman Bayou	1.0	1.0	0.0
8.0	R	Odenburg	1.5	1.0	0.5
10.0	L	Jacoby	1.7	0.0	1.7
12.5	R	Cason	2.0	2.0	0.0
13.5	L	McCrea	1.3	1.0	0.3
14.5	R	Woodside	3.1	2.5	0.6
17.0	L	Provosty	2.0	1.5	0.5
18.5	R	Crooked Bayou	2.1	1.8	0.3
21.5	L	Mercier	2.8	2.0	0.8
23.5	R	Barberton	0.9	0.7	0.2
24.0	L	Evans Point	1.3	0.9	0.4
25.5	R	Goudeau	1.0	0.8	0.2
26.5	L	Morris Bayou	1.2	0.7	0.5
27.5	R	Goodwood	1.6	1.6	0.0
28.5	L	Red Cross	1.6	1.5	0.1
29.5	R	Melville	1.5	0.9	0.6
31.0	L	Cross Bayou	1.1	0.7	0.4
32.0	R	Melville South	1.7	0.8	0.9
34.6	L	Toles	2.0	1.2	0.8
35.5	R	Petite Prairie	1.6	1.6	0.0
37.0	L	Holloway Lake	1.4	1.4	0.0
38.0	R	Three Mile Bayou	0.7	0.0	0.7
38.5	L	Bayou Sherman	1.0	1.0	0.0
40.5	R	Krotz Springs	3.0	0.9	2.1
40.5	L	East Krotz Springs	1.4	0.0	1.4
43.5	L	Sherburne	1.8	1.3	0.5
44.5	R	Bayou Big Graw	2.7	1.6	1.1
48.0	L	Coswell Bayou	1.1	0.0	1.1
48.5	R	Courtableau Bayou	1.2	0.0	1.2
50.0	L	Alabama Bayou	1.4	0.0	1.4
52.0	R	Indian Bayou	1.4	0.0	1.4
53.0	L	Happytown	1.3	0.0	1.3
54.0	R	Otis Landing	1.1	0.0	1.1
115.0	L	Morgan City Front	1.1	0.6	0.5
		TOTAL	65.1	40.4	24.7

* Red River

(2) Quantities of Material. The volume of upper bank soils that would be graded into the river during the 18-year construction period (1982-2000) is approximately 11,950,000 cubic yards. Total gravel, oyster shell, or stone that would be placed on the upper river bank is approximately 1,123,300 tons, while 430,200 squares of ACM would be placed below the LWRP. Based on an annual average construction rate of 1.3 miles per year, approximately 650,000 cubic yards of material would be dredged into the river each year, while 61,100 tons of gravel, oyster shell and stone, and 23,400 squares of ACM would be placed on the river bank. Approximately 300,000 cubic yards of bank grading, 12,000 tons of stone and 10,000 squares of ACM would be involved in annual maintenance work.

(3) Source of Material. The material graded into the river would be naturally occurring alluvium from the river bank. Stone and gravel would be obtained from various quarries and gravel pits in the Lower Mississippi Valley. Concrete blocks forming the ACM would be manufactured at casting fields at several locations along the river.

e. Description of the Proposed Discharge Sites.

(1) Location. The locations of revetments to be constructed are shown on Plates 2 through 7.

(2) Size. Disposal areas would be the river banks, channel slopes, and adjacent water column where bank grading and revetment placement occur. The average lengths of the revetment construction sites would vary from approximately 1,000 feet to approximately 11,580 feet. Graded materials would be deposited on the channel slope to a distance of approximately 200 feet riverward of the low water line. The project would require approximately 2400 acres of bank and river bed to be covered by ACM.

(3) Type of Site. The disposal and fill sites would be unconfined and in open water.

(4) Types of Habitat. Existing habitat consists of natural bank habitats, including early and mid-to-late successional bottomland hardwoods and cypress-tupelo. Approximately 130 acres of bottomland hardwoods and 120 acres of cypress-tupelo would be impacted. The areas that are cleared for construction access, but not revetted would revegetate with early successional bottomland hardwoods. Existing subaqueous habitat is characterized by moving sediments, the majority of silt or clay size.

(5) Timing and Duration of Discharge. Revetment construction and repair would be done during the low water season, beginning with bank clearing and degrading in late August and September, and continuing with revetment placement repairs until complete, in November or early December. Each phase of work would proceed

sequentially by site in the upstream direction. The duration of discharge would be concurrent with the bank grading and revetment placing operations, and would vary from a few days to a month or more, depending on the size of the job. Maintenance work at and near construction sites would normally be performed during the construction phase.

f. Description of Disposal Method. The construction site would first be cleared of vegetation and debris. Clearing would extend to about 150 feet landward of the top of bank, and be accomplished by bulldozers, draglines, and smaller equipment. Removed material would be either buried, spread along the landward limit of the site or be completely removed from the site. Clearing limits would normally be about 50 feet beyond the area to be degraded to provide adequate accessibility for all operations.

The bank would then be degraded to a predetermined stable slope. Bulldozers would excavate and move material from above the water line toward the river, from where barge-mounted draglines would pull the material by excavating with the large scraper equipped with cutting teeth along its bottom edge. The excavated material would be engulfed and pulled by the scraper beyond the grading limits and be deposited on the channel slope. Some of the material would be carried away by river currents, while the rest would remain to be covered by the ACM. Degrading is not usually extended to below 15 feet of the low-water line at time of construction. A 6-inch layer of shell or gravel would then be placed on the finished slope to prevent erosion before placement of the ACM. This material would continue to serve as a filter medium after revetment placement.

The ACM would then be installed over the entire degraded area and riverward to about 50 feet beyond the channel thalweg (deepest point). Beginning at the downstream work limit, a barge would be positioned against the bank for the purpose of assembling and launching the precast (25 by 4 feet) concrete squares. After each row of squares was assembled and tied to plate anchors on the bank, it would be lowered from the barge to the river bank and the next row of squares would then be tied together and to the preceding row with wire, and the sequence repeated until the required riverward limit of that section was reached. Each subsequent section (upriver) would be placed to overlap that previously placed to ensure complete coverage. This method of construction would minimize any tendency for river currents to flip the upstream edge of an ACM section. At the upstream end of the site, a double thickness of ACM would be placed for the same reason.

Upper bank paving with stone would follow the ACM placement. Barge-mounted draglines would lift the stone from another barge and deposit it along the degraded bank.

Major maintenance work might consist of replacing portions of an ACM where erosion has occurred. If bank erosion has occurred in upper bank areas, degrading would first be accomplished to a stable slope as before, and ACM placement and upper bank paving would then be accomplished to complete the process.

III. Factual Determinations.

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. The soils graded into the river from banks would generally be transported by currents as suspended or bed load for a short period. Therefore, no significant changes in elevation or slope of the channel bottom would be expected as a result of grading bank materials into the river. The placement of revetment on the graded bank would result in a change in bank slope and elevation from that of the generally steep and irregular natural bank to a uniform slope ranging from 1 vertical on 3 horizontal to 1 vertical on 7 horizontal. The average graded slope would be 1 vertical on 5 horizontal.

(2) Sediment Type. Bank grading would not result in significant alteration in sediment composition of the receiving area since the material to be graded would be of alluvial origin and of similar grain size. The ACM revetment would result in a change in substrate from alluvial sediments to concrete mattress on the lower bank. The upper bank protection materials would result in a change in substrate from alluvial sediments to stone and shell or gravel on the upper bank. Interstices between ACM slabs, buckling of the mat, and deposition of sediments on the revetment would provide some natural substrate.

(3) Dredged Material Movement. Most of the soil graded from the river bank into the channel would be transported downstream as bed or suspended load by currents. Some of the graded material would remain along the underwater bank to be covered by the concrete mattress.

(4) Physical Effects on Benthos. Construction of the revetment and consequent river disposal of soils would destroy existing benthic populations over 2,400 acres of river bottoms. Due to high turbidity, shifting substrates, and high current velocities, the Atchafalaya River generally does not support a large benthic community. However, the bank areas and channel area above the river bed, although representing a limited percentage of the underwater area, are highly productive at all trophic levels. Factors which cause this productivity include reduced current velocity, increased availability of cover, and substrates exposed to sufficient light to

allow algae growth. These bank areas would be permanently altered at all revetment sites. In time, sediment deposition on the revetment would restore some areas of original habitat and sparse recolonization would occur by epibenthos on the ACM.

b. Water Circulation, Fluctuation, and Salinity Determination.

(1) Effects on Water.

(a) Salinity. No substantive effects.

(b) Water Chemistry. Alkalinity and pH would not be significantly altered by the proposed revetment action due to the similarity of soils, the high suspended sediment capacity of the river, and the frequency of natural bank erosion. The construction materials would not affect water chemistry since cement and stone are essentially inert.

(c) Clarity. Water clarity would be reduced during the grading and disposal operation, creating a sediment plume which would be visible downstream of each site. This condition would be temporary and would dissipate after the grading and disposal is complete. The revetment itself would not significantly affect water clarity, but the cumulative effect of all Atchafalaya River channel improvements may be improvements of river water clarity.

(d) Color. Water color would be affected similarly to water clarity.

(e) Odor and Taste. No sustained effects on water odor or taste would be expected as a result of revetment construction.

(f) Dissolved Gases. The only dissolved gas of concern is oxygen. Data from 2 years of monitoring by Louisiana State University indicates DO is highest in January-February and lowest during July-August-September. Much of this seasonal change is due to temperature alone since colder water holds more oxygen in solution. The low discharge rate of the late summer and fall further contributes to the seasonal low in DO levels. In November the fall phytoplankton bloom usually occurs, thereby stimulating DO levels. Revetment construction occurring in the fall months would be expected to have short-term adverse effects on DO in the vicinity of each revetment site because of disturbed photosynthesis whenever turbidity levels are raised.

(g) Nutrients. Nitrogen and phosphorus levels are normally adequate in the Atchafalaya River but do not lead to eutrophic conditions since the high turbidity of the river prevents abundant plant growth. No significant effect would therefore be expected from graded sediments releasing nutrients into the water.

Ammonia is also present and is toxic to aquatic life in un-ionized form. However, at the nearly neutral pH of the river the percent of ammonia-nitrogen in un-ionized form would be low. Together with a large dilution capacity this fact should prevent any toxic ammonia problems.

(h) Eutrophication. No eutrophication problems would be expected as a result of disposal of bank soils into the river. High turbidity maintains a limited photic zone, thereby inhibiting plant growth.

(2) Current Patterns and Circulation.

(a) Current Patterns and Flow. Revetment structures would stabilize caving and eroding banks, thereby achieving a more consistent channel alinement. Overall, current patterns would not be grossly altered. Revetment placed on concave banks of bendways would tend to cause channel deepening at the toe of the revetment and narrowing of river width with resulting localized increases in velocities and bed scour.

(b) Velocity. The smooth texture and even grade of the revetment structure, compared with the existing irregular banks, would tend to increase velocities in the immediate area of the revetment.

(c) Stratification. Revetment works would not induce stratification in the naturally turbulent river.

(3) Normal Water Level Fluctuations. Individual revetment sections would not have measurable effects on water level fluctuations. However, the effect of the complete revetment program would be to lower stages because of channel deepening caused by higher velocities and lack of available bank sediment. The resulting deeper channel would have an increased hydraulic efficiency resulting in generally lower river stages.

(4) Salinity Gradients. Not applicable.

(5) Actions Taken to Minimize Impacts. Other than construction of revetment sections to desired grade and careful engineering to insure construction to desired specifications, no actions would be taken to minimize impacts.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Sites. The grading operation would increase suspended particulate and turbidity levels in the channel at and downstream of the work site during construction.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be decreased in the vicinity of each revetment during construction. This effect would disappear after cessation of construction activities.

(b) Dissolved Oxygen. The 12 million cubic yards to be removed from the river banks could add an average of 228,000 tons of COD to the main channel water during the construction period. This quantity of COD would correspond to approximately the mean background load of COD of the Atchafalaya River over an 11-day period. This incremental increase in daily COD should not cause significant dissolved oxygen reductions beyond the zones required for mixing and dispersion.

(c) Toxic Metals and Organics. The amount of suspended sediment carried by the Atchafalaya River is dependent on streamflow, turbulence, sediment particle size, water temperature, and sediment availability. Commonly more than 90 percent of the contaminant load is associated with suspended sediment, thus keeping dissolved contaminant concentrations low. Suspended sediment discharges at Simmesport at the head of the project area show that an average of 108 million tons of total suspended sediment flows through the project area annually. Approximately 77 percent is silts and 23 -percent sand. The annual average suspended solids concentration is 550 mg/l. During the construction season, August through December, suspended solids range from a low of about 55 mg/l to a high near 550 mg/l, with the concentration dependent upon streamflow, turbulence and availability of sediments. The bank grading operation and the placement of revetment on the graded bank would not be expected to significantly increase contaminants in river waters. The bank soils graded into the river were deposited and have been reworked by the river over time. As a result, the reintroduction of sediment to the river channel should not constitute an additional loading of the system with contaminant materials. Natural bank caving by fluvial action is continuous and occurs on bank lines where the revetment is constructed. The river is steadily reintroducing the alluvial bank soils to main channel waters. The construction work would accelerate, to a moderate degree, the introduction of the soils into the river. Revetment works would tend to retard bank erosion and reduce the further introduction of sediments into the river over the long term. With the lack of significant industrial, municipal or agricultural drainage areas in this reach of the Atchafalaya River, river bank materials are expected to be comparatively free of contaminants. Table G-11-2 displays results of a single sample analysis completed in 1981 at River Mile 55. The elutriate tests did not detect the introduction of any toxics due to discharge of bank sediments into the river, although some substances could not be measured at levels comparable to EPA criteria.

TABLE G-11-2

WATER AND SEDIMENT DATA
SITE NO. 5, 1981
ATCHAFALAYA RIVER, MILE 55

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					68.9
Total Volatile Solids					0.96
Turbidity	53,000				
Suspended Solids	55,300				
Volatile Suspended Solids	18,400				
Oil and Grease					990
Chlorides	30,000				
COD	28,000	11,000	17,000		20,500
TKN	580		1,180		168
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	37		39		< 0.20
Nitrate-N	1,320		1,170		< 0.20
Total Nitrogen-N	1,900		2,390		168
Ammonia-N	41		542	20**	10.7
OrthoPhosphate-P	76	78	22		2.10
Total Phosphorus-P	180	< 100	< 100		345
Calcium	37,400	36,900	40,700		
Magnesium	10,600	10,100	11,100		
Manganese	117	< 1	1,240		233
Iron	3,960	198	71	1,000	7,810
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	3	1	< 1	3.8*	86.3
Zinc	< 25	< 25	< 25	47	44.6
Chromium	1	< 1	< 1	0.29	8.88
Cadmium	0.3	0.3	< 0.1	0.025*	0.21
Copper	4	2	3	5.6	6.63
Nickel	2	< 1	< 1	96*	18.2
Arsenic	2	1	< 1	40	3.32

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

(d) Pathogens. The small amounts of untreated waste that normally enter the river channel directly or through erosion of sediments should not increase significantly because of bank grading operations.

(e) Esthetics. During construction the temporary plume of turbidity might not be visually pleasing to many observers.

(3) Effects on Biota.

(a) Primary Production. The Atchafalaya River is a detritus-based system with fine particulate and dissolved organic matter from the watershed and floodways providing the primary energy source for the ecosystem. Consequently, aquatic primary productivity in the main river channel is not of major importance in the energy budget of the river ecosystem. High ambient turbidity, shallow euphotic zone, and natural turbulence of the river diminish the importance of primary productivity and photosynthetic activity in the river channel. Short term effects of the bank grading operation on primary productivity and photosynthetic activity would be considered insignificant. Long term and cumulative effects of bank stabilization with revetment placement might be an overall decrease in river turbidity and an increase in the importance of primary productivity of the river system.

(b) Suspension/Filter Feeders. Increases in suspended particulates associated with bank grading would not be expected to significantly affect suspension feeding benthic organisms outside the immediate locations of the construction sites. Suspension feeding macroinvertebrates in the river are adapted to the normally high concentrations of suspended particulates although some mortality could occur among sedentary species during construction. Those mobile suspension or filter-feeding organisms might vacate the area downstream until conditions returned to near normal. Recolonization after revetment operations ceased would be expected to be rapid in areas with unaltered habitat.

(c) Sight Feeders. No significant effects are expected on sight-feeding species. Sight feeders, principally fish species, would vacate or avoid the construction site and associated area of increased suspended particulates during the period of construction activity. Fish species in the Atchafalaya River are adapted to naturally high turbidity or suspended solids levels.

(4) Actions Taken to Minimize Impacts. No actions to minimize impacts during construction would be taken.

d. Contaminant Determinations. Data taken by the Corps of Engineers on dredging operations in the Lower Atchafalaya River have shown that contaminant levels of main channel waters would not be

increased over ambient levels. Although dredging operations differ considerably, the bank grading operation and placement of revetment on the bank would not be expected to introduce new contaminants, but might temporarily increase or relocate contaminants in the river water during construction. Since no significant contamination would be expected no further testing of sediments was done.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Phytoplankton populations in the Atchafalaya River are generally sparse. The principal group consists of diatoms, with the most common genera being Melosira, Cyclotella, and Navicula, with lesser numbers of green algae and desmids. Zooplankton is comprised of numerous species of rotifers, with copepods, cladocerans such as Daphnia and Bosmina, and other groups being less abundant. Construction during the fall months has the most chance of harming the plankton community. (The period least harmful to plankton with regard to disruption of the river environment would be June through August.) However, the plankton community is extremely adaptive due to its rapid and massive reproduction potential. The relatively short duration of the individual discharges associated with revetment construction and the small volume of water that would contain greater than normal suspended particulate loads indicate that effects of the discharge on plankton associations would be negligible.

(2) Effects on Benthos. The natural steep or bluff banks of the Atchafalaya River support small to large populations of benthic invertebrates depending on stability or rate of caving of the bank, and the sediment type. The clay plug and other stable deposits of sediments may support very productive populations. The characteristic and most abundant benthic species at most natural bank sites which would be affected by revetment work are burrowing larvae of the mayflies Tortopus and Pentagenia. Other common benthic organisms that occur at most natural bank sites include the amphipod Gammarus, the pelecypod Corbicula, the oligochaete Limnodrilus, and the chironomid Polypedilum. Caddisfly larvae may also be abundant on tree limbs and similar submerged substrate. Benthic organisms are absent or very sparse in the generally coarse, shifting bed load sediments of the main channel. Grading and paving of the bank with revetment materials result in destruction of the natural habitat and the associated benthic community.

Recolonization of the revetted bank by indigenous bank dwelling species would occur on sediments accreted on the ACM and on the natural bank sediments beneath the ACM where buckling occurs and in the interstices between the blocks comprising the mat. Some epibenthic organisms such as leeches or caddisflies would colonize the ACM mat; however, these organisms would probably be sparsely distributed. Recolonization of available substrate would be rapid because of the constant source of benthic organisms. On the whole,

diversity of the benthos would be less on a revetted versus natural bank. For a single revetment this diversity loss would not be significant, though from an overall project viewpoint a reorganization of the ecological network would be expected.

(3) Effects on Nekton. The main river channel and natural banks support an abundant and diverse fauna of typical river fishes such as flathead, blue and channel catfish, buffalo, carp, bass, crappie and drum, plus gar, shiners and minnows. It is not expected that the disposal of graded bank material in the river adjacent to the bank would adversely affect fish populations because of the short duration of the bank grading operation at any particular site, the fact that fish would temporarily move from the immediate disposal area, the relatively small area of the expected turbidity plume and the adaptation of most river fishes to high turbidity and suspended sediment concentrations. Changes in water quality such as decreased dissolved oxygen which might occur at the construction site would be avoided by nekton. Toxic effects of the discharge are not anticipated.

(4) Effects on Aquatic Food Web. Since detritus comprises the basis of the energy system in the Atchafalaya River, no significant adverse effects on the aquatic food web should occur.

(5) Special Aquatic Sites.

(a) No wildlife sanctuaries or refuges, mud flats, vegetated shallows or riffle and pool complexes would be adversely affected by the revetment construction activity.

(b) Wetlands. In the project area late successional hardwoods and cypress-tupelo forest types located along the river bank are listed as special case wetlands by EPA (Federal Register Vol. 45, No. 208, page 70565) and, consequentially, could be classified as wetland types subject to Section 404 jurisdiction. However, since no dredged or fill material would be placed in forested wetlands as a result of revetment construction, no evaluations of the wetlands under Section 404 are required. In the jurisdictional area of the United States District Court for the Western District of Louisiana, including this portion of the Atchafalaya River, the court ruled that the clearing of bottomland hardwood forests using bulldozers and similar equipment constitutes the discharge of dredged material into the waters of the United States. Therefore, the clearing of vegetation from the top bank using bulldozers during revetment construction could be subject to Section 404. Approximately 24 miles of revetment remain to be installed on the Atchafalaya River during the remaining 18-year authorized construction period, or an average of 1.3 miles per year. Typically, an area up to 150 feet landward of the top bank would be cleared of vegetation during bank grading. A total of 250 acres for

the 23.9 miles of revetment to be constructed on the Atchafalaya, or approximately 10.5 acres per year of forested wetlands, would be permanently destroyed by the revetment construction. This loss due to the revetment construction program is considered insignificant. Approximately the same area would be destroyed by bank caving if revetment were not constructed.

(6) Threatened and Endangered Species. No threatened or endangered species or their critical habitat would be adversely affected by revetment construction and bank stabilization measures. A complete discussion of endangered and threatened species is contained in Appendix H.

(7) Other Wildlife. The loss of natural streambank habitat as a result of revetment construction is not considered significant since this habitat would be lost over time by bank caving if revetments were not constructed. The area that is cleared and allowed to revegetate would provide browse for deer while in its younger stages.

(8) Actions to Minimize Impacts. There are no practical measures that could be taken to minimize impacts.

f. Proposed Disposal Site Determinations.

(1) Mixing zones for suspended sediments were calculated using average annual values of stream flow and suspended sediment concentrations at Simmesport. Results are summarized in Table G-11-3. The mixing zone required to dissipate the discharge of graded bank to a level of 1.25 times the average ambient concentration of suspended sediment requires a maximum of 9 water surface acres in September to a minimum of 1.1 water surface acres in December. This amount is not considered ecologically significant.

(2) Compliance with Applicable Quality Standards. Louisiana numerical water quality standards for the portion of the Atchafalaya River in which revetment construction will take place are:

Chloride	65 mg/l
Sulfate	70 mg/l
Dissolved oxygen	5.0 mg/l
pH range	6.5 to 8.5
Temperature	33°C
Total dissolved solids	440 mg/l

The bacterial standard applied to this river reach is for Primary Contact Recreation, the highest water use category. Based on not less than five samples taken in a 30-day period, fecal coliforms are not to exceed a logarithmic mean of 200 colonies/100 ml, nor are more than 10 percent of total samples taken in any 30-day period to exceed 400

TABLE G-11-3

MIXING ZONE CHARACTERISTICS DEGRADING OPERATION,
ATCHAFALAYA RIVER REVETMENT CONSTRUCTION

Parameter/Month	August	September	October	November	December
Average Flow (cfs)	110,000	87,000	92,000	104,000	147,000
Average Suspended Sediment (mg/l)	237.6	219.2	297.6	297.1	426.8
1.25 x Average Suspended Sediment (mg/l)	297.0	274.0	372.0	371.4	533.5
Flow Required to dilute Discharge to 1.25 Average Suspended Sediment (cfs)	25,235	27,357	20,144	20,173	14,042
Percent of total flow Required for Dilution	23	32	22	19	10
Width of Front Edge of Mixing Zone (ft)	337	365	269	269	187
Length of Mixing Zone (ft)	1,358	1,540	840	893	293
Total Affected Water Surface (acres)	7.6	9	4	4.3	1.1
Time of Transport Through Mixing Zone (minutes)	15	17	9.3	9.9	3.3
Ratio of Width of Mixing Zone to Average River Width	.176	.191	.14	.14	.098
$\bar{x}$ Daily Suspended Sediment Load (thousands of tons)	3548.4	2900	2967.7	3466.7	4741.9
Percent of $\bar{x}$ Daily Suspended Sediment Load Degraded, per day	3.8	4.7	4.6	3.9	2.9

colonies/100 ml. In addition to these standards, general criteria dealing with esthetics; color; floating, suspended and settleable solids; taste and odor; toxic substances; oil and grease; foaming or frothing material; nutrients; and turbidity are applicable to the Atchafalaya River.

The only category of toxic substances determined to be applicable to dredged material pursuant to Section 307 of the Clean Water Act of 1977 is polychlorinated biphenyls. This class of chemicals has been detected in the Atchafalaya River, but not in the reach subject to bank stabilization.

Based on available water quality data, the alluvial nature of the soils, the inert character of revetment construction materials, mixing zone and elutriate test data available, and the short duration of the construction work period at any particular site, applicable water quality standards would not be exceeded, nor would any ephemeral increases in water column chemical constituents associated with revetment construction be considered ecologically significant.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No effect, since there are no water intakes downstream of revetment sites.

(b) Recreational and Commercial Fisheries. No effect.

(c) Water Related Recreation. A minor temporary effect would be expected.

(d) Esthetics. No significant adverse effects are expected on the river with the exception of the time of construction activity at any given site. Although ACM and stone on a recently revetted bank differs greatly from its natural appearance, most revetment ultimately becomes vegetated and assumes a natural aura.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites and Similar Preserves. A complete discussion of cultural resources is found in Appendix E. At the present time, no properties listed in the National Register of Historic Places or Historic Sites are located in the construction zone. The principal jeopardy to any unknown site in the immediate construction area or between the levees is bank caving, which the bank stabilization program is designed to prevent. Specifications for revetment construction require that any item of historical or archeological interest which may be discovered be reported to proper athorities and that work cease until the items can be classified. No national seashores, wilderness areas, research sites or similar preserves are located at the revetment sites.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The construction of revetment works would result in a general reduction of bank caving rates and resultant introduction of sediments to the river. There would be a net loss of natural bank habitat for benthos and fish populations. At the time of project completion 50-percent of the river banks in this reach would be permanently altered. The main channel would tend to deepen. Overall species diversity would decrease as bankline conditions become more uniform.

On the Mississippi River reach from Old River to the Arkansas River, installation of revetment is directly associated with a 92 percent reduction in bank caving in the 40-year period since the revetment construction program was initiated. Similar data do not exist for the Atchafalaya River; however, bank caving should also be significantly reduced through the construction period. Currently bank caving rates in the Atchafalaya River average 25-feet per year on cutting banks. The likely effects of the reductions would be a slight decrease in turbidity and increase in water clarity with corresponding positive effects on aquatic biota. The overall effects of the short term grading of soils at an average of 1.3 miles per year for the life of the project are not considered ecologically significant. The total average annual volume of dredged material generated by bank grading is approximately 650,000 cubic yards, or about 0.9-percent of the total annual suspended sediment discharge of the river (average discharge period of record October 1975 through September 1977). The average bank grading operation would increase the total daily suspended sediment load of the river by approximately 4.7-percent in September to 2.9-percent in December. Table G-11-3 lists percent increase, by month, for the August to December construction period.

Any reduction in benthic production may adversely affect fishery production since most of the common river fishes are bottom feeders during at least some portion of their life cycle. Long term reduction in sediment input to the river as a result of bank stabilization and associated decreases in turbidity could, however, increase the potential for primary production during summer and fall low-flow periods.

(g) Determination of Secondary Effects on the Aquatic Ecosystem. Secondary effects of greatest concern are the possibilities of development induced by the project. As a result of bank stabilization some new development might occur near Simmesport and the West Atchafalaya Basin Floodway. Depending on the type of development additional impacts on the environment might be expected.However, existing or recommended easements for the remainder of the project reach would serve to minimize secondary effects.

III. Findings of Compliance for Revetment Construction, Bank Stabilization, Mainstem Atchafalaya River (River Miles 1.0-55.0 and River Mile 115).

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. The following are less environmentally damaging alternative disposal sites that were considered for disposal of bank grading material. These alternatives would require the use of pipeline hydraulic dredges, hopper dredges, and/or land-based draglines.

(1) Placement of material from bank grading on flood plain behind the top bank was considered. This alternative would eliminate significant sediment input to the river from bank grading and would create elevated mounds of dredged material that would be of limited value as wildlife habitat, especially during floods. However, this disposal site alternative would require the additional clearing of approximately 1,000 to 1,500 acres of woodlands during the remaining revetment construction period. This disposal method would require new bank grading equipment and modification of existing equipment at tremendous costs. Most of the existing grading plant would become obsolete. Also, the bank grading rate (linear feet per day) would be slowed, resulting in substantially increased costs and delays in revetment work that would have adverse effects on bank stability and eroded sediment inputs.

(2) Placement of soil from bank grading on cleared flood plain lands between the top of the bank and the levee was considered. This alternative would have considerable advantages from an ecological standpoint. However, transporting of material to these locations, requirements for new bank grading equipment, and loss of efficiency would severely limit the revetment construction program and greatly increase costs.

(3) Placement of soil from bank grading on cleared lands on the landside of the levee was considered. This alternative would have similar advantages to those of alternative 2. Disadvantages would also be similar to those of alternative 2 but of greater magnitude.

(4) Placement of soils from bank grading in river channel areas of low velocity was considered. This disposal site alternative would decrease the rate of sediment loading to the river channel. However, major new equipment outlays and modification of existing plant would be required, and efficiency and speed of bank grading would be reduced, thereby significantly increasing costs. In addition, locations having reduced current velocities in the river tend to be the most biologically productive habitats. Therefore, it is concluded that the proposed site for graded bank soils is the most practicable alternative considering a balance of both economic and environmental considerations.

c. There are no alternative sites for placement of revetment materials. In order to be effective for bank stabilization and channel alinement, the revetment must be located in the areas where banks are caving and the structure must extend from the top of bank elevation down the bank slope to the thalweg.

d. Use of the proposed disposal sites would not violate any applicable State Water Quality Standards and would comply with applicable toxic effluent standards or prohibitions under Section 307 of the Clean Water Act. Turbidity might rise significantly above ambient levels, but would not be expected to impact a large portion of the channel cross-section. There is no evidence of violations of applicable State of Louisiana water quality standards that would be associated with revetment construction.

e. Use of the selected disposal sites would not harm any endangered species or their critical habitat or violate protective measures for Marine Sanctuaries.

f. The proposed disposal of dredged material would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be significantly affected. There would be a cumulative effect due to the permanent alteration of half of the area's natural bottom habitat. Net significant adverse affects on aquatic ecosystem diversity, productivity and stability, and recreational, esthetic and economic values would not occur.

g. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic ecosystems include the placement of filter material along the water line to minimize erosion from wavewash during construction.

h. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

Channel Training above Morgan City Outlet Flow Distribution

I. Project Description

a. Location. This evaluation addresses impacts of two major features of the Atchafalaya Basin Floodway project: channel training of the Atchafalaya River above Morgan City, Louisiana, between river miles 90 and 116 (all mileage described is in 1963 river miles); and control of outlet flow distribution. Also included is an evaluation of possible minor bank maintenance which may be required along the main channel from above mile 53 to mile 90.

b. General Description. The Atchafalaya River is formed near Simmesport, Louisiana, where Old River and Red River meet. The river then flows about 140 miles to Atchafalaya Bay, an arm of the Gulf of Mexico. The Atchafalaya River is the major distributary of the Mississippi River, and the basin through which it flows serves as a major floodway during times of high flow.

The Atchafalaya Basin Floodway consists of three separate floodways: the West Atchafalaya and Morganza Floodways to the north, and the Lower Atchafalaya Basin Floodway to the south. The Lower Atchafalaya Basin Floodway begins about the latitude of Krotz Springs and extends southward to the vicinity of Morgan City. The Atchafalaya River in the area of proposed channel training varies from a well-defined main channel between about mile 55 and mile 95, to a somewhat braided channel between mile 95 and mile 116 as the river flow passes through the Grand and Sixmile Lake areas.

More detailed descriptions of the project area are in Section 5 of the Environmental Impact Statement (EIS) and in the Technical Appendixes, especially Appendix A. Plate 1 is a General Map of the area.

c. Authority and Purpose. Channel training above Morgan City and outlet distribution control are authorized by the Flood Control Act of 15 May 1928, Public Law 391-70, as amended. As a part of the overall plan for the Atchafalaya Basin Floodway System, the post-authorization study was authorized by the discretionary authority of the Chief of Engineers by letter dated 18 June 1976. This letter directed development of alternative plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project.

The purposes of channel training above Morgan City are to accelerate development of a main channel through the lower floodway and to prevent further sedimentation adjacent to this reach, which results in loss of floodway capacity. The majority of the works would be below mile 94 and would confine flow to the main channel. Material dredged from the channel would be deposited in low bank areas and gaps to prevent overflow during low to moderate flow periods. Low back levees

would prevent runoff of sediment into adjacent areas. Minor bank maintenance along the main channel might be required above mile 90 to prevent crevassing of existing banks. The purpose of the outlet work would be to maintain an approximate distribution of outlet flows of 70 percent via the Lower Atchafalaya River and 30 percent via the Wax Lake Outlet. Results would be monitored to determine the feasibility of changing the flow distribution to 80/20, provided the flood control capacity and ecosystem responded favorably. This control would be effected by the building of a stone weir and connecting levees upstream from Wax Lake Outlet.

d. General Description of Dredged or Fill Material. The channel training material would be dredged from the main channel and placed along the channel banks. The approximate ratio of sand to silt would be 3:1 and about 29 million cubic yards would be required. For outlet controls the weir would be built of stone and the levees of clay. The top 50 feet of soil in the vicinity of the connecting levees is composed of fat clays having a soft to medium consistency. The estimated quantity of fill required for levee construction is 250,000 cubic yards. The material would be taken from a borrow pit south of the levee.

e. Description of the Proposed Discharge Sites.

(1) Location and Size. Plate 9 shows the general location of the proposed channel training works. The presently estimated location of those works is given in Table G-11-4 and indicated on Plate 10. In this rapidly changing area, other disposal sites might be utilized and some shown on Plate 10 may be deleted. Thus, this evaluation will cover any and all channel training works necessary between miles 90 and 116. In a worst case situation, approximately 5,500 acres would be utilized for disposal. Plate 10 also indicates the location of the weir and levees that would control outlet distribution. It can be seen that from mile 101 to mile 106 the channel training works and outlet control levees would be coincident and run along the middle of Cypress Island. Gaps would be left in the channel training works at approximately miles 106 and 113 to allow some flow through in the Berwick/Morgan Island area.

(2) Types of Sites. The dredged material would be placed in confined disposal areas along the banks of the river to simulate natural ridges. These ridges would be constructed to a height equal to the average annual flood, or about 5 to 7 feet National Geodetic Vertical Datum (NGVD) and would be approximately 1,000 feet in width. Above mile 90, material would be placed as required to prevent or repair crevasses in existing banks. The Wax Lake Outlet control levees would be built to be overtopped by a flood occurring once every 10 years on the average. These levees would have a crown elevation of 10 feet, a 20-foot crown width, 1V:4H side slopes and berms, and would slant across Cypress Island to tie in with the West Atchafalaya

TABLE G-11-4

CHANNEL TRAINING

Location (1963 Mileage)	Descending Bank	Channel Enlargement (sf)
93.7-96.0	Right	6,000
96.8-100.5	Right	12,000
101.0-101.5	Left	4,000
101.5-102.0	Left and Right	8,000 (total)
102.8-104.0	Right	4,000
104.0-105.5	Left and Right	10,000 (total)
105.5-107.0	Left	5,000
107.0-107.8	Right	4,000
107.8-108.4	Left and Right	7,000 (total)
108.4-110.4	Left and Right	7,000 (total)
113.5-116.0	Left	8,000

Basin protection levee. The two-stage stone weir at the head of Cypress Island would be overtopped at all times.

(3) Types of Habitat. Between river miles 90 and 116, discharge of dredged material would occur in three habitat types: cypress-tupelo, early successional bottomland hardwoods, and open water. Approximate acreages affected are: 400 acres of cypress-tupelo, and 4,950 acres of early successional bottomland hardwoods (primarily willow flats). The amount of shallow open water that would be used for disposal is not accurately known at this stage of design, but would probably be in the range of 200 acres. Above mile 90, minor bank maintenance might be required, but acreage affected would be small. If work is required in this reach, primarily the bottomland hardwood habitats would be the type affected. For outlet distribution control not coincident with channel training, approximately 26 acres of early successional bottomland hardwoods would have dredged material deposited on them.

(4) Timing and Duration of Discharge. Work would be accomplished primarily during average to low flow conditions. Channel training construction activity from mile 90 to mile 116 would extend over several years. The possibility of minor bank stabilization work above mile 90 would exist for the project life. The outlet control work could extend over 2 years.

f. Description of Disposal Method. Hydraulic dredging would be used for the channel training work. The levees would be built by casting dredged material from the adjacent borrow pits. The weir would be constructed of riprap from commercial producers outside the area.

II. Factual Determinations

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Existing elevations in the wetland and terrestrial disposal sites vary from 0 to 2 feet NGVD to 10 to 15 feet NGVD. Disposal for channel training would create simulated natural ridges not less than 5 to 7 feet NGVD that would confine moderate and low flows to the main channel. Initially, these banks would be overtopped an average of once in 2 years. As natural levee formation progresses, overtopping would occur less frequently. The open water disposal would generally occur in areas less than 20 feet in depth, except in some passes which may be deeper. Disposal for outlet control would create a levee approximately 10 feet high that would regulate low to moderate flows into Wax Lake Outlet. The control weir would be overtopped at all flows.

(2) Sediment Type. The dredged material for channel training would be primarily sand with some silt which would be similar to sediment in the disposal areas, with the exception that it would contain less organic material. Soils from both dredging and disposal sites are of alluvial origin. Soils in the cypress-tupelo disposal areas could be slightly finer than the dredged material. The dredged material forming the levee would be mostly fat clay and would be similar to the clay in the disposal area.

(3) Dredged/Fill Material Movement. The channel training dredged material would be confined and the effluent returned to the main channel through controlled spill gates. Effluent discharge rates and suspended solid concentrations would be dependent on: elevation, height, and length of outlet weirs, surface area and geometry of containment sites, rates of discharge into sites, and distance from the end of the discharge pipe to the outflow location. Some movement of dredged material from the channel training sites may occur during high flows, but overall deposition of sediment in off-channel areas would be reduced. Any dredged material that is eroded from the levee would generally return to the adjacent borrow pit. It would be physically compatible with those sediments.

(4) Physical Effects on Benthos. Benthic organisms at the disposal sites for the channel training and outlet work would be destroyed by burial, although only the open water and cypress-tupelo habitats support resident populations. Such swamps are the most productive benthic habitat in the basin. Seasonal use of the bottomland hardwood habitats within disposal sites by benthic organisms would be precluded or reduced. Subaqueous benthos would be destroyed at the dredging sites. In addition, removal of organic material from the channel would reduce both food sources and substrate diversity. Loss of bank vegetation would reduce the amount of detritus added to the river system.

(5) Other Effects. Widening and deepening the channel would tend to increase the constantly changing nature of the substrate. Widening would increase the fine particle levels and might encourage sporadic deposition by reducing velocities and particle carrying capacity. Existing vegetation in the channel training disposal sites would be destroyed, but would revegetate over time to early successional bottomland hardwoods. Most cypress-tupelo habitats would be lost. Kinds and numbers of animals using the disposal sites would be dependent on the successional stage of the vegetation in the areas. The levees for the outlet flow control would not revegetate with forest but remain open land.

(6) Actions Taken to Minimize Impacts. The channel training alternative is the least environmentally damaging of the alternatives that would accomplish project purposes. The discharge would be confined to the smallest practicable area, and the effluent returned to

the main channel to preclude possible adverse impacts in off-channel areas. Natural revegetation of the disposal areas would occur within 1 to 2 years. The channel training works on the right descending bank would be coincident with the outlet control levee for at least five miles. It is possible that the outlet levee would be coincident with the channel training works from mile 101 to mile 108.5. This would shorten the levee length by approximately 1 mile, but would mean that the ten-foot high levee would be 8.2 miles in length instead of seven miles. The final alinement would be determined by environmental and engineering considerations.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water.

(a) Salinity. No effect from channel training. Control of the outlets could reduce flows out Wax Lake Outlet to 20-percent which could somewhat deter the freshening trend in East and West Cote Blanche Bays.

(b) Water Chemistry. The waters of the Lower Atchafalaya River can be generally characterized as turbid (the mean value for suspended solids is 237 mg/l), slightly alkaline (pH 7.5), moderately oxygenated (50-100 percent of saturation), and nutrient-rich. Effluent from the channel training disposal areas and runoff from the levee would contain higher concentrations of suspended solids than the receiving waters. Dissolved oxygen would also be reduced, at least initially. However, these effects would be localized and of little significance. Secondary effects of the channel training work and levee construction would be to reduce overflow into off-channel wetlands and water bodies in the Berwick/Morgan Island area. Sedimentation in this area would be reduced, which would prolong its existence as wetland and aquatic habitat. Turbidity would be decreased under moderate to low flow conditions, with a resultant increase in primary production. Temperatures may be somewhat higher during periods when the amount of colder river water entering this area is reduced. Algal activity should increase, but effects on most water quality parameters should be insignificant. Channel training and outlet control should have no significant affect on pH in the river or the adjacent areas.

(c) Clarity. Water clarity would be increased in areas protected from direct river overflow by channel training and/or the levee. No measurable effect would occur in the main channel except in localized areas during dredging and drainage of effluent.

(d) Color. No significant effect.

(e) Odor. No significant effect.

(f) Taste. No significant effect.

(g) Dissolved Gas Levels. Effluent from initial disposal operations would likely be low in dissolved oxygen from contact and mixing with organic material in the dredging and disposal sites. Effects would be localized and temporary as the main channel receiving waters generally contain adequate oxygen levels. However, input of large organic loads to the channel could incur large oxygen demand, especially when construction occurs during low flow periods. The Berwick/Morgan Island area would have decreased turbidity and higher primary production than at present. Therefore, dissolved oxygen may be reduced in these areas during periods following high biological activity.

(h) Nutrients. The effluent draining into the river may be higher in nutrients than the receiving waters, however, any effects on nutrient levels would be localized and temporary. Nutrient levels in these areas along the main channel partially isolated from river overflow by channel training and/or the levee might be reduced since riverine waters in the Atchafalaya Basin are a primary source of nitrogen and phosphorus. However, nutrient levels in these areas would not likely fall below levels which are limiting to biological productivity. Within the main channel nutrient levels would increase dramatically due to construction activities, then decrease dramatically as the detrital sources are reduced. Gradually, nutrient levels would return to near normal as the flood plain area revegetates.

(i) Eutrophication. There should be no significant effects due to naturally high turbidity.

(2) Current Patterns and Flow. The objective of channel training is to confine moderate to low flows within the main channel. This confinement would not affect water levels in off-channel areas to the north since they also receive water from other sources, but would reduce inflow of generally more turbid, more oxygenated, and more nutrient-rich water. Changes in current patterns would occur in these areas, especially as various distributaries became blocked. The Berwick/Morgan Island area would receive reduced river flows at low to moderate water levels and thus circulation would be impeded at those times. The outlet control feature might eventually reduce the percentage of flow through the Wax Lake Outlet to 20 percent. This could change current patterns in Atchafalaya Bay.

(a) Velocity. During moderate to low flows water velocity would be decreased in off-channel areas, especially in the Berwick/Morgan Island area. Velocities in the main channel would tend to increase, but this effect would be tempered by the increased cross-sectional areas. Velocities would become much more uniform with areas of high and low velocities disappearing. If the outlet control feature reduces flows in Wax Lake Outlet to 20 percent, velocities would slightly decrease in Wax Lake Outlet and increase in the Lower Atchafalaya River.

(b) Stratification. No effects.

(c) Hydrologic Regime. The channel training works would accelerate main channel development by confining most flows to the main channel. This would reduce frequency of overbank flows into off-channel areas along the main channel, especially in the Berwick/Morgan Island area, and thereby reduce sedimentation in these areas. The basic hydrologic changes would be more flow in the main channel and less flow in other areas along the main channel. Water levels in off-channel areas would not be significantly affected, however, as these areas receive water (ground or surface) from other sources. The trend would be toward higher water levels in these areas as the region continues to subside. The outlet control feature would maintain present percentages of flow at the outlets at first. If the percentage via Wax Lake Outlet were later reduced to 20, there would be no further development of its channel, but development of the Lower Atchafalaya River would increase.

(3) Normal Water Level Fluctuations. During moderate to low flow conditions the channel training works and levee would prevent direct river flow into off-channel aquatic habitats along the main channel, but water level fluctuations should not be significantly affected except, perhaps, in the Berwick/Morgan Island area. During high flow events the low ridges or levee would be overtopped and river water would flow directly into and through the off-channel areas. Overall sedimentation rates and turbidity in the off-channel areas would be reduced, and dissolved oxygen may be lowered, primarily during the summer and early fall. The weir would slightly affect normal water level fluctuations along Wax Lake Outlet.

(4) Salinity Gradients. Since control of the outlets to 70/30 would slightly reduce the percentage of flow via Wax Lake Outlet at low flows, the marshes and bays to the east of the Lower Atchafalaya River would become fresher while the marshes and bays west of Wax Lake Outlet would become more brackish. These trends would be intensified if the outlets were controlled to a 80/20 distribution.

(5) Actions That Will be Taken to Minimize Impacts. The selected channel training alternative is the least environmentally damaging alternative that would accomplish project purposes, and would result in reduced sedimentation in off-channel habitats. Presently, this sedimentation is resulting in the conversion of aquatic habitat to sandbar and willow flat habitat, and is reducing the flood capacity of the floodway. The disposal areas would be confined to the smallest size practicable, and the effluent returned to the main channel where its effects would be minimal. Also, during detailed design further consideration would be given to measures that would provide for increased circulation in selected off-channel aquatic habitats. There would be no action taken to minimize impacts to water circulation and salinity caused by the outlet flow distribution feature.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Sites. The Lower Atchafalaya River and Wax Lake Outlet are turbid and have high concentrations of suspended sediments. The dredged material from channel training is predominately sand with some silt, and would be placed in confined areas to keep lateral movement and filling of aquatic and terrestrial habitat to a minimum. The effluent from the confined disposal areas would be returned to the main channel and should not increase suspended particulates or turbidity above ambient levels except in the immediate discharge area. Impacts at the dredging sites would be long term. Dredging for channel training would occur over a period of several years. The material utilized to build the levees would be clay and some runoff would be expected. During construction localized increases in suspended particulates and turbidity would be expected. After dredging is finished at each site sediment discharge would decrease, however, higher than normal levels would be expected while the channel adjusts to its new flow regime. Deposition would increase slightly in the delta region during the construction and adjustment periods. It would remain at higher than present rates as the project would direct sediment to the delta rather than the flood plain. In off channel areas particulate loads would decrease on an annual basis.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Turbidity and suspended solids levels are naturally high in the Atchafalaya River Main Channel. Therefore, although particulate levels would be elevated due to channel alterations and readjustment, little noticeable effect would be expected. In off-channel areas light penetration should increase due to being cut off from the main channel. Construction of the stone weir flow distribution structure should have negligible effects on water column light penetration. The composition of core material collected in the vicinity of the proposed connecting levees of this feature ha been estimated to be 31 percent sand, 35 percent silt, and 34 percent clay. Construction of the levees would present opportunities for sediment loss with temporarily increased suspended solids and turbidity levels and consequent temporarily reduced light penetration in adjacent water bodies and wetlands.

(b) Dissolved Oxygen. The mean COD of 14 core material samples collected in 1976 from the Atchafalaya River Main Channel and adjacent overbank areas was about 21,800 mg/kg (43.6 pounds of COD per ton of solids). Consequently, the COD to be satisfied in the Atchafalaya River Main Channel waters might, on average, be increased by about 44 pounds for each ton of solids lost during material excavation. This figure does not include the COD of bottom sediment interstitial waters released to the water column during dredging.

Because the Atchafalaya River Main Channel has a relatively large dilution capacity, the additional demand on oxygen resources caused by channel training and outlet flow distribution work should not be of much consequence. However, the COD of low DO effluents released from dredged material containment areas may cause DO depression in adjacent shallow wetlands. The severity of DO depression in these shallow waters would depend upon the quantity and quality of the discharged effluents.

(c) Toxic Metals and Organics. The amount of suspended sediment carried by the Atchafalaya River is dependent on streamflow, turbulence, sediment particle size, water temperature, and sediment availability. Commonly more than 90 percent of the contaminant load is associated with suspended sediment, thus keeping dissolved contaminant concentrations low. Suspended sediment discharges at Simmesport at the head of the project area show that an average of 108 million tons of total suspended sediment flows through the project area annually. Approximately 23-percent is composed of sand and 77-percent silt. The annual average suspended solids concentration is 550 mg/l. During the construction season, August through December, suspended solids range from a low of about 55 mg/l to a high near 550 mg/l, with the concentration dependent upon streamflow, turbulence and availability of sediments. The dredging operation to enlarge the channel is not expected to significantly increase contaminants in river waters. Elutriate tests indicate that few highly toxic substances in sediments would become available to aquatic life at harmful levels. With the lack of significant industrial, municipal or agricultural drainage areas in this reach of the Atchafalaya River, river bed materials are expected to be relatively free of contaminants. Table G-11-5 displays results of a single sample analysis completed in 1981 at river mile 110. This sample did not detect the introduction of any toxics, other than copper, due to mixing sediments with river water. However, detection limits above the criteria level did not allow positive determinations for some substances.

(d) Pathogens. Since there is no municipal sewage outfall within several miles of these features, an increase in pathogens due to dredging is unlikely.

(e) Esthetics. The increased turbidity caused by dredging would not be noticeable except in localized areas for a short duration.

(3) Effects on Biota.

(a) Primary Production, Photosynthesis. Primary production in large, turbid alluvial rivers like the Atchafalaya is low, with most of the system's food supply coming from outside the river in the form of organic detritus. Covering more than 5,000 acres of cypress-tupelo and bottomland hardwoods with dredged material from channel training and outlet distribution control works would

TABLE G-11-5

WATER AND SEDIMENT DATA
SITE NO. 17, 1981
ATCHAFALAYA RIVER, MILE 110

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					78.3
Total Volatile Solids					0.20
Turbidity	29,000				
Suspended Solids	43,200				
Volatile Suspended Solids	12,900				
Oil and Grease					428
Chlorides	30,000				
COD	11,000	9,000	17,000		8,520
TKN	610		560		8.20
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	36		20		< 0.20
Nitrate-N	1,580		1,770		< 0.20
Total Nitrogen-N	2,230		2,350		8.20
Ammonia-N	28		51	20**	0.612
OrthoPhosphate-P	83	28	43		1.31
Total Phosphorus-P	140	100	150		248
Calcium	39,100	36,800	37,900		
Magnesium	11,100	11,100	11,000		
Manganese	76	1	19		103
Iron	1,970	38	< 25	1,000	3,810
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	4	1	1	3.8*	29.5
Zinc	< 25	< 25	< 25	47	13.5
Chromium	2	< 1	< 1	0.29	3.88
Cadmium	0.5	0.5	< 0.1	0.025*	0.53
Copper	5	4	6	5.6	0.55
Nickel	< 1	< 1	< 1	96*	8.74
Arsenic	1	1	1	40	1.25

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

temporarily remove a significant source of detrital energy from the lower Atchafalaya ecosystem, but revegetation with early successional bottomland hardwoods would occur rapidly. The aquatic primary production in the cypress-tupelo habitats would be lost. Reducing river overflow to off-channel aquatic habitats, especially the Berwick/Morgan Island levee, would result in reduced turbidity and an increase in potential for primary production and photosynthesis in these areas. Also, reduction in sedimentation would prolong the productive lives of these aquatic habitats.

(b) Suspension/Filter Feeders. Riverine habitats in the Atchafalaya Basin generally support sparse benthic populations compared to other aquatic habitats. For example, the mean number of benthic organisms per square meter in riverine areas was found to be 327, as compared to 1,840 in headwater lakes, 3,292 in bayous, and 3,768 in swamps. Tubificid worms, chironomids, and Asiatic clams are commonly found in riverine habitats. Initially, these organisms would be lost at the dredging sites, but recolonization would eventually occur. In disposal sites, the loss of cypress-tupelo habitat (which supports the largest number of benthic organisms) would result in the reduction of populations of amphipods, clams, dipteran larvae, snails, and isopods. The bottomland hardwoods that are used as disposal areas for channel training and outlet control works would no longer be available for colonization by benthos at low and moderate flows. These areas would be wet only during high flow events.

(c) Sight Feeders. No appreciable effects on sight feeders should occur in the vicinity of dredging operations. About 400 acres of cypress-tupelo swamps, which support sight feeders such as largemouth bass, bowfin, shad, warmouth, and crappie, would be lost. Use of other terrestrial habitats in the disposal areas by sight feeders during moderate to low flows would be eliminated. Reduction of turbidity in off-channel areas would result in improved conditions for sight feeders in those aquatic habitats.

(4) Actions Taken to Minimize Impacts. See section II.a(6).

d. Contaminant Determinations. The material proposed for discharge is similar to that in the disposal sites, and contaminant levels are generally low (see Table G-11-5). The proposed discharges should not significantly introduce, relocate, or increase contaminants. Since no significant contamination would be expected, no further testing of sediments was done.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations in the Atchafalaya River and Wax Lake Outlet consist mainly of diatoms, desmids, rotifers, cladocerans, and copepods. No group is abundant. No significant effects would occur on plankton in the main channel. Plankton populations in disposal areas, primarily confined to the

cypress-tupelo habitats, would be lost. Reduced turbidity in off-channel areas may benefit some plankton species, but overall effects should not be significant.

(2) Effects on Benthos. See Section II.a.(4) and II.c.(3)(b).

(3) Effects on Nekton. There would be no significant effects in the main channel or Wax Lake Outlet. Fish populations in cypress-tupelo habitats in disposal areas would be lost, and use of other habitats in disposal areas by fishes would be greatly reduced. Reduced sedimentation and turbidity in off-channel aquatic habitat, especially the Berwick/Morgan Island area, should be beneficial to many species of fish such as bass, crappie, and bluegill.

(4) Effects on Aquatic Food Web. Loss of over 5,000 acres of vegetated aquatic and terrestrial habitat would reduce detrital material available for processing and use in the aquatic food web. However, in light of the total amount of aquatic habitat available in the project area, the effect is not considered significant. Some shift in kinds and numbers of aquatic organisms would likely occur in off-channel areas as they become more lentic or lake-like in character.

(5) Special Aquatic Site Effects.

(a) Wildlife Management Areas. All channel training works above mile 96 and those between miles 96 and 101 on the left descending bank are in the Attakapas Wildlife Management Area. The disposal would destroy existing forested areas, but would reduce sedimentation in the off-channel areas.

(b) Wetlands. As noted earlier, for purposes of this evaluation, all habitats found in the proposed disposal areas (cypress-tupelo, mid-to-late successional bottomland hardwoods, and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would destroy existing vegetation and plant succession would begin within a year. The disposal area would become early successional bottomland hardwoods prior to 2030. Wetland values of the disposal areas would be reduced due to loss of cypress-tupelo habitat and the reduced flooding effected by the channel training works and levees. Wetland values of off-channel aquatic habitats will be enhanced and preserved in many instances due to reduction of sedimentation and turbidity. The overall effects, considering the vast acreages of wetland and aquatic habitat in the basin, would be minor.

(c) Mudflats. There could be, by the time of construction, some unvegetated mudflats in the area affected by channel training or outlet flow control. These flats would arise by sedimentation in this dynamic riverine system. They would be covered

by disposal of dredged material. This impact would not be significant because of other mudflat areas available nearby.

(6) Threatened and Endangered Species. No significant effects. See Appendix H and Section 6, paragraph 6.287 of the EIS for detailed discussion.

(7) Other Wildlife. The proposed discharge would result in the immediate loss of over 5,000 acres of terrestrial wildlife habitat, including approximately 400 acres of cypress-tupelo, and 4,950 acres of early successional bottomland hardwoods. All disposal areas except the levees should revegetate with early successional bottomland hardwoods. The mid-to-late successional bottomland hardwoods provide the best wildlife habitat in the basin, with an abundance of soft and hard mast-producing trees, a diverse woody understory, and abundant herbaceous groundcover. Early successional bottomland hardwoods of the type found in the proposed discharge sites (primarily young, dense stands of willow) do not represent a quality habitat for most species of wildlife, but are heavily used by certain seasonally abundant species such as the yellow-rumped warbler or by white-tailed deer when basin water levels are low. The cypress-tupelo swamp habitats are primarily utilized by wildlife species that are water-oriented at some stage of their life cycle, such as, furbearers, herons, egrets, ibises, and wood ducks. They are less productive overall than the more mature bottomland hardwoods, but more productive than the early successional bottomland hardwoods.

(8) Actions to Minimize Impacts. All effluent from the channel training works would be returned to the main channel. Discharge would be confined to the smallest practicable area. Should the outlet distribution levee be made coincident with the channel training works for the longer distance, wetland loss might be further minimized.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. The mixing zone will be the localized area in the vicinity of the construction works and the effluent from the confined disposal sites which discharges into the main channel of the Lower Atchafalaya River.

(a) Depth of Water at Disposal Site. Depth of water for disposal of material will range from less than 1 foot to generally not greater than 10 feet. Where effluent from disposal sites is discharged back into the main channel water depths will generally be less than 10 feet. Water depth at the weir site is several feet deep.

(b) Current Velocity, Direction, and Variability at the Disposal Site. Current velocities will generally range from 1 to 5 feet per second. Flow direction is downstream, although some eddy

currents are present. Since the work would be done during moderate to low flow conditions, variability would be moderate.

(c) Degree of Turbulence. The Lower Atchafalaya River is naturally turbulent. Disposal of dredged material would increase turbulence in localized areas, but would also reduce overflow and turbulence in off-channel areas. Discharge of effluent into the main channel would not have significant effects.

(d) Stratification. No effects.

(e) Rate of Discharge. Discharge would be by hydraulic dredge for the channel training works and by bucket dredge for the levee. Rate of discharge would be in the general range of 500 to 1,000 cubic yards of dredged material per hour.

(f) Ambient Concentration of Constituents of Interest. Ambient suspended sediment concentrations in the Lower Atchafalaya River are high and average about 250 mg/l. Nutrients are fairly high, heavy metals and pesticides are low. Results from a single sample taken at river mile 110 are shown in Table G-11-5.

(g) Dredged Material Characteristics. See paragraph I.d.

(h) Number of Discharge Actions Per Unit of Time. Dredging would occur primarily during the summer and fall months (moderate to low flow conditions) and would extend over several years for channel training and over approximately two years for outlet control. The rate of discharge would depend on the size of dredge and operating conditions, but would be in the general range of 500 to 1,000 cubic yards of dredged material per hour.

(2) Determination of Compliance with Applicable Water Quality Standards. The Louisiana State Water Quality Standards for this reach of the Atchafalaya River (headwaters to Mile 118) are shown in Table G-11-6.

Additional State of Louisiana non-numerical criteria and standards are listed in Table G-11-6A.

The disposal of dredged material would cause some increases in turbidity and decreases in dissolved oxygen, but these would be localized and temporary. The material from channel training would be placed in confined sites. The effluent would be returned to the main channel of the Atchafalaya River. Soil, water, and elutriate analyses conducted in the Sixmile Lake area indicate the materials to be dredged are relatively free of contaminants. Thus, based on available water quality data, the nature of the receiving waters, the mixing zone and the elutriate test data, it does not appear that applicable water quality standards would be exceeded, nor would any temporary

TABLE G-11-6
NUMERICAL WATER QUALITY CRITERIA
LOUISIANA DEPARTMENT OF NATURAL RESOURCES

SEGMENT DESCRIPTION	WATER USES[1] A	B	C	D	CL	SO4	DO	PH RANGE	BAC STD[2]	TEMP	TDS
Atchafalaya River - Headwaters (Barbre Landing) to mile 118 (1.2 miles below mouth of Bayou Boeuf) (includes Grand Lake and Sixmile Lake)	X	X	X	X	65	70	5.0	6.5 TO 8.5	1	33	440
West Atchafalaya Borrow Pit Canal (St. Landry and St. Martin Parishes)	X	X	X		100	75	5.0	6.0 TO 8.5	1	32	500
Atchafalaya River - mile 118 to Atchafalaya Bay (Tidal)	X	X	X		N/A	N/A	4.0	6.5 TO 9.0	1	35	N/A
Intracoastal Waterway (North-South) - Bayou Sorrel to Morgan City		X	X		80	75	5.0	6.0 TO 8.5	2	32	500
Intracoastal Waterway (East-West) - Bayou Boeuf Locks to Wax Lake Outlet		X	X		150	75	5.0	6.0 to 8.5	2	32	500
Wax Lake Outlet (Tidal)		X	X		N/A	N/A	4.0	6.5 TO 9.0	2	35	N/A
Atchafalaya Bay (Tidal)		X	X		N/A	N/A	5.0	6.5 to 9.0	4	35	N/A

1/ A = Primary contact recreation
B = Secondary contact recreation
C = Propagation of fish and wildlife
D = Domestic Water Supply

2/ #1 PRIMARY CONTACT RECREATION - Based on a minimum of not less than 5 samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 200/100ml. nor shall more than 10 percent of the total samples during any 30-day period exceed 400/100ml.

#2 SECONDARY CONTACT RECREATION - Based on a minimum of not less than 5 samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 1,000/100ml. nor shall more than 10 percent of the total samples during any 30-day period equal or exceed 2,000/100ml.

#3 PUBLIC WATER SUPPLY - The monthly arithmetic average of total coliform MPN (most probable number) shall not exceed 10,000/100ml. nor shall the monthly arithmetic average of fecal coliforms exceed 2,000/100ml.

#4 SHELLFISH PROPAGATION - The monthly total coliform median MPN (most probable number) shall not exceed 70 per 100ml. and not more than 10 percent of the samples ordinarily exceed an MPN of 230/100ml.

TABLE G-11-6A
QUALITATIVE WATER QUALITY CRITERIA
LOUISIANA DEPARTMENT OF NATURAL RESOURCES

PARAMETER	CRITERIA (Summarized as applicable)
ESTHETICS	Waters shall be maintained in an aesthetically attractive condition and shall be free from discharges sufficient to result in objectional color, odor, taste, and turbidity, or to injure animals or plants, or to produce undesirable aquatic life.
COLOR; FLOATING, SUSPENDED, SETTLEABLE SOLIDS; and TURBIDITY	True color shall not be increased to the extent that it would interfere with present or projected usage. Increased color, in combination with turbidity, shall not reduce the depth of the photosynthesis compensation point more than 10 percent from the seasonally established norm. There shall be no substantial increase in ambient turbidity due to waste discharge.
TASTE and ODOR	Production of potable water by reasonable treatment methods shall not be interfered with. No unpalatable flavor shall be imparted to food fish or shellfish, nor shall offensive odors arise from waters.
TOXIC SUBSTANCES	These shall not be present alone or in combination in quantities that would be toxic to animal or plant life. In all cases the level shall not exceed the Median Tolerance Limit (TL_m) 96/10.
NUTRIENTS	The naturally occurring nitrogen-phosphorus ratio shall be maintained.
OIL and GREASE	These shall not be present in quantities that interfere with designated uses.

increase in water column chemical constituents associated with channel training or outlet control works be considered ecologically significant.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. There would be no effects since there are no municipal water intakes within, or downstream of, the construction area.

(b) Recreational and Commercial Fisheries. See Section II.c.(3). The loss of about 5,550 acres of aquatic and seasonally flooded terrestrial habitat would adversely affect recreational and commercial fisheries to an unknown, but probably minor, degree. The disposal areas would revegetate and furnish organic detritus to the aquatic food web, however, they would be flooded less frequently than they are presently. These areas would be used by aquatic and semi-aquatic animals during high water periods. The recreational and commercial fisheries in the off-channel areas, especially in the Berwick/Morgan Island area, would be improved somewhat as a result of reduced sedimentation and would remain aquatic habitat for a longer period of time. Overall effects, considering the type and quantity of aquatic habitat in the basin and the rapidly changing (from aquatic to terrestrial) character of the areas proposed for disposal sites, are not significant.

(c) Water Related Recreation. Some small passes used by recreational boaters would be closed to navigation, although water access to most areas would still be available by other routes. Major passes to recreational waters, such as American Pass, would not be modified.

(d) Esthetics. Disposal areas would be unsightly until revegetation occurs. Loss of some 400 acres of esthetically pleasing cypress-tupelo habitat would occur. The increased turbidity during construction would be unpleasing, but this effect is minor and temporary. Reduced turbidity and sedimentation in some off-channel aquatic habitats would be beneficial to esthetics in those areas.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. There would be no effects on any such areas.

f. Determination of Cumulative Effects on the Aquatic Ecosystem. The channel training works above Morgan City are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall, then, the plan

would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000, 332,000, and about 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent, of these habitat types.

The terrestrial habitat loss caused by the two features considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. The loss of open water habitat caused by these features would also be small in comparison to the acreage available, but exact figures are not obtainable. The open water areas to be filled are primarily small shallow passes with relatively swift currents and shifting sand substrates, and as such generally provide poor aquatic habitat.

Channel enlargement between mile 90 and 116 would eliminate the diversity of subaqueous conditions in that reach. A uniform channel would have more uniform bank habitat, flow patterns, temperature gradients, and flood stages. Shifting bed loads, areas of scouring and deposition, and increased particulate loads would be expected to continue to exist. These occurances would inhibit normal aquatic growth. The delta area at the river mouth would aggrade slightly more rapidly than present with fine sand and silt layers. Increased channel capacity would reduce overflow and use of the floodplain as a source of organic nutrients and detritus. Runoff from adjacent areas might increase which could decrease the amount of water available to sustain base flow during dry conditions.

Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

g. Determination of Secondary Effects on the Aquatic Ecosystem. Secondary impacts on the aquatic ecosystem include the 50 acres of early successional bottomland hardwoods and 10 acres of cypress-tupelo that would be utilized as borrow areas for these two features. Other secondary impacts such as confinement of river flows from river mile 90 to 116 and reduction of sedimentation in off-channel areas have been discussed previously. The channel training would aid in preservation of the Upper Belle River area. The channel

training on the north bank is a feature of this possible management unit and its construction would reduce sedimentation into the unit even without construction of other works. The weir at the head of Wax Lake Outlet would have very little impact on bed load transport. If the distribution of flows were changed to 80/20 in the future, less sediment would flow down Wax Lake Outlet and the delta there would develop more slowly and the delta below the Lower Atchafalaya would prograde more quickly. The additional growth of the delta would contribute to some small degree to the increased flooding in the backwater area east of Morgan City.

III. Finding of Compliance for Channel Training above Morgan City and Outlet Flow Distribution.

a. No significant adaptions of the guidelines were made relative to this evaluation.

b. There are no alternative sites which would accomplish the objectives of the channel training and have less adverse impact on the aquatic ecosystem. The size of sites would be kept to the minimum and effluent from the confined sites would be returned to the main channel where effects on the aquatic ecosystem would be minimal. Closure of potential or actual crevasses above mile 90 can only be made at those sites and the overall effect of such actions, if needed, would be to reduce degradation of backwater aquatic ecosystems as a result of sedimentation. There is no practicable alternative site for the weir in Wax Lake Outlet that would have less adverse impact on the aquatic ecosystem. An alternative alinement exists for the levee and it will be investigated further at later stages of the project.

c. Use of the proposed disposal sites would not violate state water quality standards to a significant degree. There would be some associated increases in turbidity and decreases in dissolved oxygen, but these would be localized and temporary.

d. Discharge would comply with applicable toxic effluent standards and prohibitions under Section 307 of the Clean Water Act.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of critical habitat.

f. The Marine Protection, Research and Sanctuaries Act of 1972 would not apply.

g. The proposed discharge would not result in unacceptable adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fisheries, plankton,

fish, shellfish, wildlife, or special aquatic sites. The discharge would likewise not result in unacceptable adverse effects on life stages of aquatic or semi-aquatic organisms, aquatic ecosystem diversity, productivity, and stability, or recreational, esthetic, and economic values.

h. Appropriate and practicable steps to minimize potential adverse impacts of the discharge on aquatic systems include confinement of sites to smallest practicable area, return of the effluent to main channel, and consideration of the alternate alinement for the levee.

i. On the basis of the guidelines, the proposed disposal sites for the discharge of dredged material are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystems.

Widening Wax Lake Outlet

I. PROJECT DESCRIPTION.

a. Location. This evaluation addresses the impact of constructing a new levee approximately 3 miles to the west of the Wax Lake Outlet (WLO) channel. This project feature is the part of the Atchafalaya Basin Floodway Project referred to as: Widening Wax Lake Outlet. The new levee would begin northeast of Shadyside, Louisiana, and run southwest across Bayou Teche ridge and old US Highway 90, continue past the Southern Pacific Railroad and new US Highway 90 to the Bayou Sale ridge, then parallel the ridge and existing levee southward to the Gulf Intracoastal Waterway (GIWW). Degrading the existing levee located adjacent to the Wax Lake Outlet and GIWW would be part of this work item (see Plate G-11).

b. General Description. The Atchafalaya River is formed near Simmesport, Louisiana, where Old River and Red River meet. The river then flows about 140 miles to Atchafalaya Bay, an arm of the Gulf of Mexico. The Atchafalaya River is the major distributary of the Mississippi River, and the basin through which it flows serves as a major floodway during times of high flow. The Atchafalaya Basin Floodway consists of three separate floodways: the West Atchafalaya and Morganza Floodways to the north, and the Lower Atchafalaya Basin Floodway to the south. The Lower Atchafalaya Basin Floodway begins about the latitude of Krotz Springs and extends southward to the vicinity of Morgan City.

(1) The Lower Atchafalaya River, with a design capacity of 1,200,000 cubic feet per second (cfs), is the natural outlet to the Gulf of Mexico for the Atchafalaya Basin. It begins just below Morgan City at the confluence of Berwick Bay and Bayou Shaffer and runs southward to Atchafalaya Bay, an approximate distance of 20 miles.

(2) The Wax Lake Outlet, with a capacity of 300,000 cfs, was constructed in 1941 to supplement the outlet capacity of the Lower Atchafalaya River. This dredged channel, located about 10 miles west of Berwick, extends from Sixmile Lake through the Teche Ridge and Wax Lake into Atchafalaya Bay, a distance of about 16 miles. The channel, constructed to a bottom width of 300 feet from Sixmile Lake to a point 0.5 mile below Bayou Teche and to a bottom width of 400 feet below that point, has a uniform depth of 45 feet below National Geodetic Vertical Datum (NGVD). By constructing a new levee approximately 3 miles back from the outlet channel and degrading the existing levee the area for overbank flooding would be increased.

(3) The distribution of flow during a project flood would change from 80/20 to about 55/45. The project flood flowline could be

(2) Sizes, Types of Habitat and Type of Sites. The new levee would occupy approximately 300 acres of cypress-tupelo wetland. The existing levee is 130 acres in extent; it would be degraded and spread over approximately 570 acres of late successional bottomland hardwoods, which are considered wetlands. It is possible that some of this material could be placed in existing borrow pits. All disposal would be classified as unconfined.

(3) Timing and Duration of Discharge. The construction of the new levee and degradation of the old levee would take approximately one year.

(4) Description of Disposal Method. Draglines would probably be used to both build the new levee sections and degrade the old levee.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations. Substrate along the route of the new levee would be mainly natural levee and marsh deposits. Substrate under the degraded levee would be mainly marsh and natural levee deposits with some backswamp deposits (see Plate G-8). Effects on:

(1) Substrate Elevation and Slope. The new levee sections would vary in elevation and slope. Current plans call for elevations from 18.7 feet NGVD near Shadyside, Louisiana, to a low of 9 feet NGVD at the GIWW. The 7.4 mile reach of the levee across the cypress-tupelo swamp would be 14.7 feet NGVD. Slopes would range from 1 on 4 to 1 on 5. The old levee would be degraded to near ground level and zero slope.

(2) Sediment Types. The new levee material would be essentially the same as that in adjacent land areas and borrow pits, therefore no significant change in substrate characteristics would result from erosion of embankment materials. The degradation of the existing levee would represent an alteration of substrate character, but placing the material in thin layers would allow gradual restoration to occur.

(3) Dredged/Fill Material Movement. Small amounts of dredged material used for the new WLO levee construction would be eroded from the embankments and would generally return to its original location (borrow area). Degraded levee material would continue to erode until it became approximately level. Some would enter Wax Lake Outlet, the GIWW, and existing borrow pits as the overbank flooded. Degradation of the existing Wax Lake Outlet levee could result in a sizeable material handling problem due to the nature and amount of material.

reduced as much as 3 feet for the West Atchafalaya Basin Protection Levee (WABPL) and East Atchafalaya Basin Protection Levee (EABPL). More detailed descriptions of the project area and features are in Section 5 of the Environmental Impact Statement (EIS) and in the Technical Appendixes, especially Appendix A. Plate 1 is a general map of the area. Plate G-11 illustrates the widening Wax Lake Outlet feature.

c. Authority and Purpose. The widening of Wax Lake Outlet is authorized by the Flood Control Act of 15 May 1928, Public Law 391-70, as amended. As a part of the overall plan for the Atchafalaya Basin Floodway System, the post-authorization study was authorized by the discretionary authority of the Chief of Engineers by letter dated 18 June 1976. This letter directed development of alternative plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project. The purpose of widening the Wax Lake Outlet overbank area is to achieve a greater flood carrying capacity in this area while protecting the natural environment. The result of this feature would be to return the additional overbank area to its more natural state of receiving tidal flows and intermittent high riverine flows.

d. General Description of Dredged or Fill Material. A new levee would be constructed to the west of the Wax Lake Outlet channel, beginning at approximately WABPL Station 5600. Relocation of old and new US Highway 90, the Southern Pacific Railroad, the West Calumet floodgate, a parish road, and various utility lines would also be required. A soil sample taken along the proposed levee alinement about 0.6 mile southwest of the railroad contained 45 percent sand, and 55 percent silt and clay. The new levee construction would require about 2.5 million cubic yards of fill material, while the levee degradation work would involve the disposal of about 1.7 million cubic yards. Quantities of earthwork required for the relocations have not been determined. Borrow material for the new levee would be dredged from adjacent landside and floodside borrow pits along most of the 8.9-mile alinement. The existing levee, extending from WABPL Station 5600 southward along WLO and westward along the GIWW, would be degraded to existing ground level. Detailed dredged and fill material handling procedures have not been formulated, but could include hauling some degraded levee material to other construction sites or borrow areas.

e. Description of Proposed Discharge Site(s).

(1) Location. The locations of the proposed levee and the levee to be degraded are shown on Plate G-11. The new overbank area south of the railroad is approximately 8,000 acres in extent, consisting of approximately 670 acres of open land, 600 acres of fresh marsh, 2,800 acres of late successional bottomland hardwoods, and 4,000 acres of cypress-tupelo swamps. North of the railroad there are approximately 1,000 acres of late successional bottomland hardwoods and 1,300 acres of open land.

(d) Color. Color would be affected in a similar manner to water clarity.

(e) Odor and Taste. No effects on water odor or taste would be expected as a result of implementing this project feature.

(f) Dissolved Gas Levels. The dissolved gas of major concern is oxygen. Oxygen levels are generally dependent on temperature in the wetland areas of the Atchafalaya. A full discussion on dissolved oxygen (DO) effects appears in Section II.c.(2).b.

(g) Nutrients. Nutrients in the WLO wetland areas are generally low. Primary production is dependent to a large degree on recycling of nutrients. Opening up a larger area for overbank flooding would increase the nutrients available to the overbank area on an annual basis. This increase would be expected to have a positive effect on the wetland areas. Nutrients produced in the newly opened overbank area could be exported to the marsh/estuarine area to the south.

(h) Eutrophication. Eutrophic conditions would not be expected as a result of levee building or degrading.

(2) Current Patterns and Circulation. Widening the WLO overbank area would increase the storage capacity of the floodplain; an additional 10,300 acres of land would be available for overbank flooding. During a project flood, widening the overbank area would allow Wax Lake Outlet to carry 45 percent of the flood instead of the 30 percent it can carry at present. The overbank would flood every other year on the average. The borrow pit dug during levee construction would change existing current patterns; it would allow drainage following floods and provide a possible route for tidal exchange.

(3) Normal Water Level Fluctuations. Widening the WLO overbank area would substantially increase water level fluctuations in the 10,300 acres that would be reconnected to riverine and tidal infuence. Flood stages along Wax Lake Outlet would be lower than present due to the increased size of the floodplain. Flow below bankfull stage would not be affected.

(4) Salinity Gradients. The increased overbank area would tend to lengthen the flood durations while decreasing flood peaks. These circumstances would moderate the salinity gradient fluctuations presently occurring downstream of this area during flood events. No effect would occur with discharges of bankfull or less.

(5) Actions That Will Be Taken to Minimize Impacts. Only the minimum amount of wetland necessary to complete project objectives would be impacted.

(4) Physical Effects on Benthos. Nearly all benthic organisms in the 300 acres of cypress-tupelo swamp filled by levee building would be destroyed by burial. No known collections have been made in these swamps, but they are highly productive. It can be assumed that benthic populations would be similar to those in the Atchafalaya Basin Floodway to the north. Species diversity should be high and crawfish, clams, fly larvae, isopods, and amphipods should be abundant. Benthos uses late successional bottomland hardwoods only on a temporary, seasonal basis. Covering 570 acres of this habitat with degraded levee would temporarily reduce future benthic use. As the widened overbank was overflowed by riverine waters, benthic productivity would be increased in those areas because they would probably be flooded longer than at present. If existing borrow pits were filled with degraded levee material, the existing benthos would be destroyed by burial.

(5) Other effects. All trees on the 300 acres of swamp where the levee would be built and on the 570 acres of woods that would have degraded levee spread on them would be destroyed. The former bottomland hardwood area would start to revegetate immediately and within 3 years would be early successional bottomland hardwoods, mostly willow. The swamp that was filled to build levee would no longer support plankton or fish. The bottomland hardwoods where the degraded levee was placed would receive reduced seasonal use by plankton and fish. Fish and plankton in any filled borrow pits would be destroyed.

(6) Actions to Minimize Impacts. Some of the material from the degraded levee along Wax Lake Outlet might be used to backfill some small and isolated borrow pits. Material from the levee north of the GIWW might be used to attempt to prevent bank erosion along this waterway. Dikes, seeding, and other practical measures would be employed to control erosion of levee materials into borrow pits, wetlands, or other water areas.

b. Water Circulation, Fluctuation and Salinity Determination.

(1) Effects on Water.

(a) Salinity. No effects on salinity would be expected due to this project.

(b) Water Chemistry. Alkalinity and pH would not be significantly affected by levee building or degrading due to the similarity of soils.

(c) Clarity. Water clarity in the surrounding waters and wetland areas would be significantly reduced temporarily. After the levee building or degrading operation, those areas remaining as wetlands would shortly return to near normal clarity. During storm events or flooding of the overbank area, additional temporary reductions in clarity would be expected until the disposal areas revegetated.

(e) Esthetics. During construction and degradation activities the spreading of the clay would degrade esthetics in the area until revegetation occurred. Post-construction esthetics would not be significantly reduced.

(3) Effects on Biota.

(a) Primary Production. Some primary productivity occurs in the cypress-tupelo swamps in the area; such productivity is probably lower than in the Atchafalaya Basin Floodway to the north because, at the present, these swamps do not receive riverine or tidal overflow, and thus are probably lower in nutrients. Diatoms, blue-green algae, and flagellates are probably common and population peaks would be expected in the summer. The turbidity engendered by levee construction would flow into the swamps adjacent to the borrow pit and temporarily reduce primary production until the levee becomes vegetated. The existing bottomland hardwoods are only seasonally flooded. Degrading the levee into such areas would temporarily reduce their potential to produce phytoplankton and benthic algae. However, as the widened overbank area is overflowed by nutrient-rich riverine waters, the 780 acres of early successional bottomland hardwoods, created because of levee degradation, would have higher primary productivity than the presently existing 130 acres of levee, 80 acres of farm land and 570 acres of woodlands. Turbidity from the degraded levee would, during construction, temporarily reduce primary productivity in the GIWW and Wax Lake Outlet.

(b) Suspension/Filter Feeders. Turbidity caused by building the new levee would affect clams, amphipods, and other filter feeders in the adjacent cypress-tupelo swamp. Turbidity engendered by degradation of the existing levee would enter Wax Lake Outlet, the GIWW, and borrow pits. If the levee was degraded during the time the nearby bottomland hardwoods were flooded, turbidity would affect the seasonal benthos there. However, all turbidity effects would occur only during construction and storm events. Effects should be of a minor nature. Once the overbank was widened, the extra nutrients and detritus carried in by the riverine waters would benefit filter feeders throughout the area.

(c) Sight feeders. The sight-feeding fish in the cypress-tupelo swamps (bowfish, shad, and crappie) would avoid the turbid area and should not be adversely affected. The catfish, striped mullet, shad, and buffalo fish that are present in the riverine waters of Wax Lake Outlet would also avoid the plume of turbidity. Once the overbank area is reconnected to the riverine system, fishery productivity would improve dramatically.

(4) Actions Taken to Minimize Impacts. See discussion in Sections II.a(6) and II.b(5).

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. This project feature would require degradation and disposal of about 1.7 million cubic yards of existing levee material, excavation of about 2.5 million cubic yards of usable material for construction of a new levee, and an as yet unquantified amount of earthwork associated with road and utility relocations. Most of this work would be performed in shallow wetland areas affording many opportunities for sediment loss in water bodies. It is anticipated that suspended solids and turbidity levels would be temporarily increased as a result of the construction and degradation activities. Leaching of spread levee materials into wetlands not initially smothered would certainly occur, but the degree of impact is highly speculative. Suspended solids and turbidity levels should gradually return to near predisturbed levels after construction activities ceased.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be temporarily reduced in the WLO area due to increased suspended solids and turbidity levels during levee building and degrading operations. Coarse solids, which would be resuspended in the water column during placement of levee material in wetlands, would settle from suspension in a relatively short period.

(b) Dissolved Oxygen. The oxygen demand of sediments resulting from levee degradation and construction in the WLO area would likely be significant. Intermittent and localized reductions in the DO content of the shallow bottomland hardwood and swamp waters would likely occur during construction of this feature. Normal DO levels in these areas are very dependent on temperature and flow conditions. At the present time the area receives no overflow from Wax Lake Outlet and is isolated from tidal exchange. The only circulation at present is the drainage of local rainfall into some areas. Widening the overbank area would allow increased circulation during high water events and on normal tidal cycles, thus increasing DO during those periods. However, flooding causes additional organic material to be deposited in the overbank area, which could reduce DO later as it decomposes. Overall, this project feature would be expected to have a positive effect on the DO quantities.

(c) Pathogens. No effects would be expected.

(d) Toxic Metals, Toxic Organics, and Biostimulants. One chemical sample was obtained from the proposed levee alinement. The analysis and implications of that sample are discussed in Section II. d. In general, toxic effects would not be expected.

TABLE G-11-7

WATER AND SEDIMENT DATA
SITE NO. 18, 1981
CANAL EAST OF BAYOU SALE RIDGE

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					30.0
Total Volatile Solids					2.28
Turbidity	5,900				
Suspended Solids	9,600				
Volatile Suspended Solids	2,000				
Oil and Grease					228
Chlorides	40,000				
COD	27,000	21,000	21,000		106,000
TKN	890		3,990		1,650
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	< 10		< 10		< 0.20
Nitrate-N	12		33		< 0.20
Total Nitrogen-N	900		4,010		1,650
Ammonia-N	32		3,150	20**	106
OrthoPhosphate-P	60	19	< 10		0.814
Total Phosphorus-P	180	< 100	< 100		1,050
Calcium	25,000	26,200	44,300		
Magnesium	7,360	7,360	767		
Manganese	176	196	714		394
Iron	1,010	155	< 25	1,000	23,600
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	2	< 1	< 1	3.8*	29.7
Zinc	< 25	< 25	< 25	47	108
Chromium	< 1	< 1	< 1	0.29	35.8
Cadmium	0.2	< 0.1	< 0.1	0.025*	0.50
Copper	< 1	3	< 1	5.6	29.2
Nickel	< 1	< 1	< 1	96*	34.8
Arsenic	3	2	4	40	6.62

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

d. Contaminant determinations. Due to the lack of contaminant sources in the Atchafalaya area, high levels of toxic materials would not be expected. One sample taken from along the proposed levee alinement was analyzed. As table G-11-7 shows, cadmium, iron, and ammonia were actually detected above EPA freshwater aquatic life criteria levels. Of these only ammonia was implicated as being released by the operations necessary for levee building or degrading. The un-ionized fraction of ammonia is considered toxic to aquatic life. For the pH and temperature conditions at the time of sampling, about 1 percent of total ammonia or about 32 ug/l of un-ionized ammonia would be present, compared to the EPA criteria of 20 ug/l. Other parameters, including cyanide, chromium and cadmium, could not be measured down to EPA criteria levels, as was the case with most pesticides that were tested. Nevertheless, the available data and other information, including dredging methods and rates of discharge, do not indicate that significant ecosystem effects would occur.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Zooplankton populations in the cypress-tupelo swamps would consist mainly of ostracods and heavy genera of cladocerans, and copepods, while in the Wax Lake Outlet lighter weight cladocerans and copepods as well as rotifers would occur. Zooplankton occupying the 300 acres of swamp to be filled by the new levee would be destroyed, and some organisms in the immediately adjacent swamp could be destroyed or physically weakened by the turbidity. Degradation of the existing levee into 570 acres of bottomland hardwoods would temporarily reduce the potential of these woods to harbor zooplankton. However, as the widened overbank was flooded, the area would furnish more habitat for zooplankton than at present. The riverine waters overflowing the land would carry in a diverse zooplankton community, as well as nutrients and detritus. Under post-project conditions, the overbank area should have greater diversity and density of zooplankton. Effects on phytoplankton would be similar and are discussed in Section II.e.(3)(a).

(2) Effects on Benthos. See section IIa(4) and IIc(3)(b).

(3) Effects on Nekton. See section IIc(3)(c).

(4) Effects on Aquatic Food Web. There would be a small but permanent decrease in aquatic productivity associated with the filling of 300 acres of swamp for levee construction. The filling of 570 acres of bottomland hardwoods would cause a temporary decrease in productivity. However, the widening of the overbank area would reconnect over 7,000 acres of wetlands south of the railroad and nearly 1,000 acres of wetlands north of the railroad to the riverine/marsh/estuarine system. This should dramatically increase aquatic productivity in the area by augmenting the amounts of detritus

(chloride, sulfate, DO, pH, coliform bacteria, temperature, and total dissolved solids). (See Tables G-11-6 AND G-11-6A.) With the possible exception of DO none of these standards would be violated. In general, the proposed action would improve existing water quality conditions.

(3) Potential Effects of Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects would be expected.

(b) Effects on Recreational and Commercial Fisheries. This project feature might improve the wetland areas in the WLO overbank, thereby benefiting recreational and commercial fisheries by improving spawning, nursery, and feeding areas.

(c) Effects on Water-Related Recreation. No significant effects would be expected.

(d) Esthetics. Degradation of the existing levee and construction of the new levee would cause temporary turbidity in adjacent areas which would reduce esthetic qualities. The degraded levee would be unsightly until revegetation occured.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. None of these types of areas would be impacted by the proposed project feature. There might be unknown archeological sites within this area. Specifications covering the work to be performed in constructing and maintaining the levee would provide for the preservation of any items of apparent historical or archeological interest.

(f) Cumulative Impacts on the Aquatic Ecosystem. Widening the Wax Lake Outlet overbank is part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the significant fish, wildlife, and other natural resources of the basin. Overall then, the plan would result in preservation and enchancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000; 332,000; and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective

and nutrients carried in by way of riverine and tidal overflow. The additional flooding would also enlarge the acreage of flooded woodland, which would expand the area available for spawning, feeding, and growth of plankton, nekton, and crawfish and other benthos. Thus, the overall effect of this feature would be environmentally positive.

(5) Effects on Special Aquatic Sites-Wetlands. As noted earlier, for purposes of this evaluation, all woodland and marsh habitats in the proposed disposal areas are considered wetlands. Construction of the new levee would permanently destroy 300 acres of cypress-tupelo swamp. Degradation of the existing levee would destroy trees on 570 acres of bottomland hardwoods. However, these acres and the 210 acres of agricultural land covered during this process would revegetate with early successional bottomland hardwoods and again be considered wetlands. The overall affect of this feature would be to enhance wetland values throughout the overbank area.

(6) Effects on Wildlife. Construction of the new levee would replace 300 acres of cypress-tupelo swamp with 300 acres of levee. The swamp is primarily utilized by water-oriented wildlife, such as furbearers, wading birds and wood ducks. The levee would provide a place of refuge during high water for the more terrestrial wildlife that also uses the swamp. Degradation of the levee would replace 570 acres of late successional bottomland hardwoods with early successional bottomland hardwoods. The quality of these late successional hardwoods is moderate to poor; therefore, wildlife loss due to habitat change should not be significant. During construction and degradation some young or slow-moving animals would be killed. Others would move to adjacent areas where they might not survive due to overcrowding.

(7) Effects on Endangered or Threatened Species. There would be no significant effects on endangered or threatened species due to this feature. See Appendix H and Section 6, paragraph 6.287 of the FEIS for a detailed discussion.

(8) Action to Minimize Impacts. See sections II.a(6) and II.b(5).

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. Mixing zone calculations are not applicable to wooded areas. Turbidity levels and leachate levels would increase in areas adjacent to levee embankment or degraded levee materials. These levels would decrease shortly after construction, but would increase intermittently during storm events. No unacceptable impacts would be expected.

(2) Determination of Compliance with Applicable Water Quality Standards. Water quality standards are established at the state level. Louisiana standards include a limited number of parameters which, in general, do not reflect industrial pollution

cause a noticeable rise in turbidity levels in the immediate vicinity of the work site. The levels would decrease soon after construction, but would increase intermittently during storm events. Since no numerical standards exist for turbidity or suspended sediment, a mixing zone could not be defined for these parameters. On a qualitative basis, no violations would be expected. There is no evidence from available data that any other regulated parameter would occupy a large enough portion of the water column to inhibit movements of free-swimming and drifting organisms. On the basis of available data, there would be no significant violations of applicable State of Louisiana water quality standards associated with implementation of this project feature.

d. No violations of the Toxic Effluent Standards of Section 307 of the Clean Water Act would be expected.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of any critical habitat.

f. No designated marine sanctuaries are in the project area.

g. The proposed disposal of dredged material would not result in significant adverse effects on aspects of human health and welfare, such as: municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, and the above-mentioned special aquatic sites. There would be no significant adverse effects on life stages of aquatic animals or other wildlife dependent on aquatic ecosystems. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability would not occur. Recreational, esthetic, and economic values would not be adversely impacted in a significant manner. On the whole, environmental values would be enriched.

h. Appropriate and practical steps taken to minimize potential adverse impacts of the discharge of material into aquatic ecosystems include using only those areas of wetlands necessary for project completion. Acreage required for the degraded levee material might be reduced by hauling it to other locations. Increased flow into the overbank area would be attained by the project. Appropriate measures to limit erosion of levee materials into aquatic areas by runoff would be employed.

i. On the basis of the guidelines, the proposed disposal sites for the discharge of fill material are generally specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

loss of 1.3, 2.7, and 6.0-percent of these habitat types. The terrestrial habitat loss caused by the feature considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Impacts. The major secondary impact of widening the Wax Lake Outlet overbank area would be the reconnection of the area to the riverine/marsh/estuarine system. The beneficial impacts of this action have been discussed in several previous sections. The most significant adverse impact would be the 300 acres of cypress-tupelo swamp that would be utilized for borrow. The trees on these acres would be destroyed as would any existing benthos. The newly created borrow pit would probably have lower benthic populations and diversity than the previously existing swamp. The passage of an increased percentage of floodwaters out Wax Lake Outlet would augment delta growth at its mouth. This would be beneficial because there is no navigation channel to be maintained (as there is at the mouth of the Lower Atchafalaya River) and thus, the delta would be able to grow undisturbed. As floodwaters entered the overbank area they would deposit sediments. Most of this deposition would be north of the Teche Ridge or adjacent to Wax Lake Outlet. It is likely that some trees would be killed by the blanket of sediment, but the number should not be significant because most trees, especially near Wax Lake Outlet, would be willows which can tolerate sedimentation.

III. FINDINGS OF COMPLIANCE FOR WIDENING OF WAX LAKE OUTLET OVERBANK.

a. No significant adaptations of the guidelines were necessary for this evaluation.

b. An early alternative to widening the Wax Lake Outlet overbank was to move the levee only 2 miles west, which would have destroyed forested wetlands. The selected alinement at the base of the Bayou Sale ridge reconnects the maximum amount of wetlands to the riverine/marsh/estuarine system. The feasibility of transporting a large portion of the degraded levee fill to other levee construction sites and/or existing borrow areas for final disposal should be explored. These uses should present fewer environmental problems than the spreading of levee fill over adjacent woodland areas. Little specific information has been developed concerning the relocated levee construction. It might become evident that departures from the construction and disposal methods now in use for the floodway levee alterations would be advisable in specific instances, particularly in the vicinity of railroad, highway, or waterway relocations.

c. The levee building and degrading operations would likely

Distributary Realinements

I. PROJECT DESCRIPTION.

a. Location. The Atchafalaya Basin main channel has four major distributary channels between river miles 50 and 80 (Splice Island Chute at river mile 72 acts as a distributary most of the time). Two of the channels distribute flows to the western floodway and two serve the eastern floodway. Their general locations are shown on Plate G-1 and their existing and proposed inlets are shown in more detail on Plates 12 and 13 of this document. The proposed inlets for two of the channels are the original distributary inlets that were filled several years ago. The existing primary diversion from the Atchafalaya River to the western floodway via the Old Atchafalaya River is located at river mile 55.0. Under the project, this inlet would be closed and replaced with a dredged channel beginning at mile 53.5 which would reconnect with the Old Atchafalaya River in a distance of 6,000 feet.

The other three distributary inlets would be similarly relocated as follows: the East Freshwater Distribution channel, from mile 71.0 to mile 68.0 (13,000 feet long); the West Access Channel from mile 77.0 to mile 74.0 (8,000 feet long); and the East Access Channel, from mile 78.5 to mile 77.5 (15,000 feet long). Table G-11-8 shows pertinent dimensions, and excavation and fill quantities for the four realined distributary channels and closure dams. Also shown are revetment quantities for erosion protection.

b. General Description. The distributary channels as presently alined have transported a large portion (up to 50 percent) of the bedload sediments, as well as suspended sediments, away from the main channel to the floodway areas. The new inlets as designed should significantly reduce the bedloads carried by the distributaries. The existing channels would be closed near their inlets, and each realined channel and main channel approach would be revetted for distances of 1,000 feet from the new inlet locations. The revetments would consist of articulated concrete mattresses (ACM) below the low water line, and stone paving from the low water line to top of bank. The actions that subject this feature to Section 404 are: (1) closure of channels; (2) disposal of excavated material in the Atchafalaya River main channel; (3) disposal on land at Old Atchafalaya River; and (4) revetment construction at all realinements.

c. Authority and Purpose. The Flood Control Act of 1928, as amended by subsequent authorization provides for various structural improvements in the Mississippi River and Tributaries system. Senate and House resolutions of 1972 authorized the development of a comprehensive plan for the preservation and management of the water and land resources of the Atchafalaya Basin. A post-authorization

TABLE G-11-8

CHANNEL REALINEMENT AND CLOSURE DATA

	Realinements						
Distributary	Length (feet)	Width (feet)	Bottom Elevation (ft NGVD)	Side Slopes	Excavation Required (cy)	Concrete Revetment Required (100 sf units)	Stone Paving Required (tons)
Old Atchafalaya River at WBPC	6,000	1,000 (top)	-15.0	1:3	3,500,000 +160,000*	6,800	13,000
West Access	8,000	60 (bottom)	-7.0	1:3	350,000 +80,000*	4,700	13,000
East Freshwater	13,000	105 (bottom)	-7.0	1:3	800,000 +90,000*	5,100	11,000
East Access	15,000	60 (bottom)	-7.0	1:3	650,000 +100,000*	5,300	11,000

	Closures				
Distributary	Length (feet)	Base Width (feet)	Bottom Elevation (ft NGVD)	Side Slopes	Fill Required (cy)
Old Atchafalaya River at WBPC	800	2,000	-15.0	1:30	860,000
West Access	250	1,100	-7.0	1:30	70,000
East Freshwater	250	1,200	-7.0	1:30	80,000
East Access	300	1,100	-7.0	1:30	90,000

* Represents bank grading required for main channel revetments.

study was authorized by the Chief of Engineers by letter dated 18 June 1976, and provided for the study to address, in specific terms, alternate plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project. The purposes of distributary realinements are to reduce floodway sediment deposition in order to more effectively contain the project flood, and concurrently to help preserve the unique environmental features and to extend the long-term productivity of the natural environment.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. At the Old Atchafalaya River site, the material is a silty clay, while at the other sites the composition varies from silty clay to sandy silt to clayey silt. One-inch diameter, 50-foot deep soil borings were taken in the Atchafalaya River main channel and adjacent overbank areas in 1976. Sieve and hydrometer analyses of the soil cores taken indicate the approximate material compositions to be as follows:

Area	% Sand	% Silt	% Clay
Old Atchafalaya River (new cut) and closure	11	26	63
East Freshwater Channel (new cut)	10-36	32-40	36-58
East and West Access Channels (new cuts) and Bayous Chene and Sorrel closures	13-36	40-49	24-38

A shallow sediment sample was taken from the site of the Old Atchafalaya River closure in 1981 (site 5). Its detailed grain size analysis is shown in Table G-11-9.

(2) Quantities of Material. The channel realinements would require excavation in the amounts of: 3,500,000 cy for the Old Atchafalaya River at Whiskey Bay Pilot Channel; 350,000 cy for the West Access Channel; 800,000 by for the East Freshwater Channel; and 650,000 cy for the East Access Channel. The quantity requirements for the closures are estimated as: 860,000 cy for the Old Atchafalaya River site; 70,000 cy for the West Access Channel; 80,000 cy for the East Freshwater Channel; and 90,000 cy for the East Access Channel. About 70,000 cy of shell would be needed for cofferdams at the closure sites. Revetment materials in the amounts of 48,000 tons of stone and 22,000 squares of ACM would be needed for bank protection. About 430,000 cy of material would be removed from main channel bank and channel slopes for preparation for revetment placement.

(3) Sources of Material. The material would be hydraulically excavated from the channel realinement routes. Sufficient portions of the dredged material from each realinement would be designated for use as fill for the respective closure dams. Shell or other suitable

TABLE G-11-9

SIEVE ANALYSIS AND GRAIN SIZE DISTRIBUTION, 1981, SITE 5

Weights (g)	Sieve Size or Number	Percent Finer
0.	No. 40	100.0
0.1	No. 50	99.9
0.8	No. 70	98.9
9.9	No. 100	86.9
23.0	No. 140	69.6
39.8	No. 200	47.4

Hydrometer

Rdgs	Temp	Size, mm	Percent Finer
13.0	24.5	0.05044	28.3
9.5	24.5	0.03687	20.9
7.1	24.5	0.02664	15.9
5.5	24.5	0.01395	12.5
4.9	24.5	0.00991	11.2
4.6	24.5	0.00703	10.6
3.8	24.5	0.00500	8.9
3.2	25.0	0.00351	7.8
3.0	23.5	0.00147	6.8

Total weight of sample - 75.6 g.

material from an outside source would probably be used to form temporary dikes that would limit water movements during closure dam construction. Stone and concrete for revetments would also be obtained from outside the project area. Material graded from the main channel bank slopes would be alluvial soils.

e. Descriptions of the Proposed Discharge Sites.

(1) Locations. Plates 12 and 13 show the channel realinement and closure dam locations for each distributary.

(2) Sizes. The designated land disposal area for the Old Atchafalaya River realinement is bounded on the west by the realined channel route and on the remaining sides by old levees. The area would occupy about 140 acres and 60 acres would be required for retaining dikes and setback of the West Atchafalaya River levee. The open-water disposal operations in the main channel would affect indeterminate acreages of river bottom. The four distributary closures would cover a total of approximately 60 acres. Revetments would also cover approximately 60 acres.

(3) Types of Sites. The Old Atchafalaya River disposal area would be completely confined by the levees and by a continuous dike along the east bank of the excavated channel. One or more weirs would be constructed along the dike to return clarified effluents to the excavated channel at acceptable suspended solids levels. The excess dredged materials from the other three realinements would be discharged directly into adjacent reaches of the main channel. Material graded from the main channel banks and channel slopes in advance of revetment placement would also be discharged directly to the adjacent channel. The four closure dams would be constructed by discharge of dredged realinement material directly into the existing distributary inlets.

(4) Types of Habitat. The confined disposal area adjacent to the Old Atchafalaya River realinement is late successional bottomland hardwood habitat. The open-water disposal areas, and revetment and closure sites constitute riverine habitats.

(5) Timing and Duration of Discharges. The dredging and disposal operations would probably be conducted during the late fall and winter months of nonflood years and should require periods varying from about 3 weeks at the West Access Channel site to about 20 weeks at the Old Atchafalaya River site.

f. Description of Disposal Method. All disposal actions from realinement excavations would be accomplished by pumping the hydraulically dredged material from channel excavations through pipelines to the disposal sites. The closure dams would be constructed concurrently with the final dredging phases for their respective

realinements. Shell-filled cofferdams would be installed near the upstream and downstream limits of each closure site immediately prior to their construction. The sloping banks of the main channel would be graded by mechanical equipment (bulldozers and draglines) to an acceptable slope before placement of ACM below the waterline and a 10-inch layer of stone above the waterline. The graded material would be discharged directly to the channel by dragline.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. Since dredged material from realinement excavations at the West Access, East Freshwater and East Access Channels would be disposed directly to the main channel, except for those portions used to make the existing channel closures, conditions would not be altered to a measurable degree. Some of the hydraulic effluent would become dispersed and resuspended in the water column and the remainder would settle and become part of the bedload. The average graded slope of the revetted main channel reaches would be 1 vertical on 5 horizontal. The closures would be built to the heights of existing banks during final stages of realinement dredging. The pumped hydraulic fill would be subject to erosion by currents during construction, and would result in significant amounts of deposition along the downstream channel bottoms, unless protective measures were taken. The channel bottoms occupying the closure sites would, of course, be permanently covered. The streambeds between each closure site and realined channel junction would undergo gradual shoaling because of the induced quiescent conditions. The realined channels would be expected to enlarge naturally to an extent during subsequent high water periods and would undergo intermittent substrate alterations as they become stabilized. The dredged material from the realinement at Old River would be disposed to a depth of 3 to 4 feet in an adjacent forested area bounded by levees. This material would constitute about one-half of the total excavated for the distributary realinements, and would remain essentially isolated from nearby water bodies. The dikes would be built to a height of 6 feet and the new west Atchafalaya River levee would be 36 feet NGVD. The revetted bank and channel slopes would be permanently changed to the design dimensions, except for accumulated sediments on ACM surfaces.

(2) Effects on Sediment Type. The disposed materials would, in each case, be very similar in physical composition to main channel and distributary channel substrate materials, and should quickly become assimilated into them. The bed materials downstream of the closures would shift somewhat toward smaller average particle sizes under with-project conditions. Revetted slopes would accumulate sediments in interstices and on surfaces with the passage of time.

(3) Effects on Dredged/Fill Material Movements. The prevailing channel currents at time of disposal would dictate the extent of lateral and longitudinal dispersion of clays and silts, and the settlement rates of sandy material. In the main channel, piped effluent would not be discharged at rates sufficiently high to permit appreciable accumulation of material near the point of discharge or elsewhere. During channel realinement excavation by hydraulic dredges, high rates of material movement would be expected near the cutterhead, but would be localized and would quickly subside during nondredging periods. The hydraulic fill closures would be characterized by turbidity plumes and downstream deposition induced by erosion and slumping of submerged embankment materials into the water column during construction in the absence of measures to minimize exposure to currents. The material graded from main channel banks into the channel in preparation for revetment placement would be slowly assimilated into the water column as bedload or suspended sediments. The degree to which material would become suspended and transported downstream would be a function of current velocity and turbulence, and the consolidation of the graded material. Only a minor fraction of the soil mass should become suspended under anticipated conditions.

(4) Physical Effects on Benthos. Riverine and distributary areas in the basin generally support sparse benthic populations (327 organisms/square meter compared to 3,292/square meter in bayous). Tubificid worms, chironomids, and Asiatic clams would be expected to be present. Distributary channel closures would bury benthos at the closure sites, and for some distance downstream if the hydraulic fill material was exposed to currents during construction. The original benthic populations at these sites would have been small, however. After construction, gradual recolonization of benthos would occur in the more quiescent downstream waters that would tend to favor larger and more diverse populations than before. Return of effluent from the diked disposal area would have little impact on benthos. Temporary benthic populations that might exist in the 200 acres of bottomland hardwoods would be destroyed by disposal. This would be a minor impact. Revetment construction in the main channel 1,000 feet upstream and downstream from each new inlet would destroy existing benthic populations on about 60 acres. In time, sparse epibenthic colonization would occur.

(5) Other Effects. All trees on the areas used for levees, dikes, revetments and disposal would be destroyed. The 140-acre disposal area would start to revegetate immediately and it would be classified as early successional bottomland hardwoods in 3 years. These trees that would have dredged or fill material placed on them are presently removed from the Atchafalaya Basin overflow system by existing levees. They would support essentially no fish or plankton populations.

(6) Actions to Minimize Impacts. The work would be timed so as to avoid high-water periods and also extreme low-water periods to provide good working conditions and to ensure that channel flows would be adequate to disperse the discharged effluents. Dikes or cofferdams constructed of shell or some other material of similar consistency should be placed upstream and downstream of each of the closure sites immediately before the addition of the pumped hydraulic fill. Thus, the exposures of unconsolidated clay particles to erosive currents would be minimized. Control of dredged material effluents from the realined Old Atchafalaya River inlet channel would be effected by the construction of a continuous dike with overflow weirs.

b. Water Circulation, Fluctuation and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. The disposal site waters are not affected by salinity.

(b) Water Chemistry. The pH levels of disposal site waters (main channel) might be slightly affected by nutrients in dredged effluents. But high background turbidity and relatively large mixing volumes would not permit other than temporary and localized shifts in pH. Construction of distributary closures could exert positive pH shifts for some distance downstream until cessation of flows. Alkalinity increases could also be effected during closure construction, but should normalize soon thereafter.

(c) Clarity. Some reduction in light transmissivity would be expected with the discharge of dredged materials. Relative changes in the main channel, however, would probably be slight because of high ambient turbidity. Noticeable effects would probably be present downstream of closures throughout the construction period, and briefly, thereafter, without erosion-prevention measures.

(d) Color. No significant discoloration of disposal site waters would be expected, unless high concentrations of organic matter would be present in dredged material (not evidenced by chemical analyses of sediment and water samples).

(e) Odor. Objectionable odors should not occur in main channel waters, where turbidity and turbulence would inhibit algal growth. Odors should not be a problem downstream of closures, either, unless nutrient levels were persistently high in eroded sediments and temperatures were favorable for algal growth, which would not be the case during the construction period (winter).

(f) Taste. Temporarily entrained organic matter or other oxygen demanding materials could possibly impart a characteristic taste to the disposal site waters, but since no public or private

water supplies are in the vicinity, no human effects would be expected.

(g) Dissolved Gas Levels. It is possible that dissolved oxygen problems could occur along the bottoms of the nearly 3-mile long portions of the East Freshwater Distribution Channel and West Access Channel that lie south of the new channel cuts. During low-water periods these areas could have little or no flow. No unusual concentrations of oxygen-demanding matter would be expected in the dredged materials, therefore, only temporary and localized oxygen deficits should occur.

(h) Nutrients. Although the disposed materials probably would contain moderate nutrient levels their discharges should not significantly affect the quality of main channel waters. Release potentials would be low at the anticipated background dissolved oxygen and pH levels. A somewhat greater potential for adverse effects would exist in the vicinity of unconfined closure construction, but induced pH changes and oxygen demands would not be persistent or widespread. Although total sediment transport through distributaries should be less under project conditions, nutrient transport would probably decrease only slightly, if at all.

(i) Eutrophication. The combination of conditions necessary for eutrophication would not exist during the disposal periods.

(2) Effects on Current Patterns and Circulation. The realinements would have the obvious effect of rerouting main channel flows. Average current velocities through the realined inlets would probably be somewhat lower, with less turbulence than under existing conditions. After construction, the realined channels would gradually stabilize through one or more annual cycles, becoming more hydraulically efficient in the process. Flow rates should be about the same as for existing conditions. The cut off portions of each distributary (between the closure and the entrance of the new channel) would have drastically reduced flows.

(3) Normal Water Level Fluctuations. No particular effects on water level fluctuations are expected in the long-term. Temporary variations from normal stages may occur during construction and for some time afterward, until the realined distributaries become stabilized.

(4) Salinity Gradients. The sites are not affected by salinity.

(5) Actions to Minimize Impacts. The disposal of dredged material directly into the main channel should have the least adverse water quality impact of the available and practicable methods for the three smaller distributary sites. The use of an adjacent land area partially surrounded by levees should likewise result in the least

water quality impact of the alternative disposal methods for the Old Atchafalaya River distributary site.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Sites. The discharges of hydraulically dredged material into the main channel would produce areas of relatively high suspended solids, and noticeable turbidity plumes whose shapes and sizes would be a function of current velocities, channel shapes and sizes, dredge pipe solids concentrations, degrees of turbulence, and background suspended solids and turbidity levels. Main channel velocities and dilution capacities would be sufficient to reduce suspended matter to acceptable levels within reasonable distances downstream. The extent and significance of distributary channel turbidities and suspended matter concentrations downstream of closures during construction would be somewhat more difficult to estimate, but would be dependent upon the volumes and rates of replacement of hydraulic fill material at the closure sites, as well as channel geometry, currents, and turbulence (which would vary as construction progressed) and background turbidity and suspended solids levels. (As noted above, such impacts could be reduced or eliminated by means of barriers to flow during closure construction.)

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Reduced light penetration would be effected by increased solids and turbidity levels. Turbidity measurements are indicators of light-scattering effects of fine suspended particles. Since background turbidity would probably be high, relative changes in light penetration of main channel waters would probably be slight even near the point of discharge. More distinct changes in light penetration would be apparent downstream of the closure sites during their construction unless erosion-prevention measures were instituted. Up to a few weeks following construction, residual effects might be noticeable, but eventually light penetration below closures would become greater than would have been the case without the project. Light penetration in the realined channels would, of course, be lowered during the dredging period near the suction head of the dredge.

(b) Dissolved Oxygen. Oxygen-demanding constituents (chiefly organic) in disposed materials directly reduce dissolved oxygen in the adjacent water column. Dredged slurries commonly contain little or no oxygen at the end of the discharge line regardless, so oxygen deficits would be expected at and near the points of discharge into the main channel. The turbulence and relatively high flow rates of the receiving water body should, however, confine significant deficits to very limited areas. During the cooler months, when construction would

probably occur, dissolved oxygen would be higher than the annual average. Some minor heating of the receiving water would be caused by absorption of sunlight by suspended particles introduced into the water column. This phenomenon, along with direct interference with reaeration processes caused by suspended particles, works to reduce dissolved oxygen in the water column. Oxygen depression in waters at and downstream of the closure sites would be more severe than in the main channel, in the absence of any measures to control erosion of newly-placed hydraulic fill. Dissolved oxygen problems could occur after construction in the portions of the distributary channels between the closures and the new channels, especially at low water.

(c) Toxic Metals and Organics. Elutriate tests do not indicate that significant releases of any of the trace metals would occur in the dredged effluents. These constituents and other toxicants, including synthetic hydrocarbons, should remain attached or chemically bonded to fine suspended particles rather than in the dissolved phase. Analyses for pesticides and other synthetic hydrocarbons were well above EPA criteria. Although ammonia would be present, the prevailing physical and chemical conditions (pH and temperature) at the discharge sites would not be favorable to the production of un-ionized ammonia gas, which is highly toxic to aquatic life. Some potential would remain for the introduction of toxicants to closed distributary channels by leaching and rainfall runoff from the closure materials. The unsubmerged portions of closure dams would be characterized by oxidized conditions, which would affect the pH of the sediments and the solubility of bound metal ions. Given the likelihood of minimal erosive rates after construction and the low levels with respect to EPA criteria of toxic metals in the sediments, the potential for significant contamination of adjacent waters would be remote.

(d) Pathogens. The Atchafalaya River is classified by the State of Louisiana as suitable for primary contact recreation, meaning that a log mean of 200/100 ml fecal coliform colonies is not to be exceeded in a series of at least five samples taken on a 30-day period. Hardly any of the materials to be dredged would have been exposed to human or animal waste material in recent history, and as such should be very low in pathogenic content. No threats to human health as a result of dredging would be anticipated.

(e) Esthetics. The increased turbidities created by dredged materials discharged into the main channel and at distributary closure sites would not be esthetically pleasing. In the main channel, the increases over background turbidities should not be easily discernible except in the immediate vicinity of the discharge locations. Distributary turbidity increases caused by uncontrolled erosion of closure dams during their construction would be more obvious, and probably would persist beyond the construction periods. In the long term, however, the reaches between the closures and the

respective realinements would become less turbid than before construction. Although revetments would not be in character with the natural environment, their erosion control effects would be esthetically pleasing.

(3) Effects on Biota.

(a) Primary Production. Primary production in a large turbid, alluvial river such as the Atchafalaya is generally low. Phytoplankton numbers and diversity are low because of turbidity, depth, and velocity. The turbidity engendered by disposal of excavated material into the river, return of diked effluent, and the construction of closure dams and revetments would temporarily reduce primary productivity. Effects in the main channel would be less severe than those downstream of closure dams. Eventually the water column in the portions of the old distributary channels between the dam and the new channel would be less turbid, thus allowing a higher primary productivity than at present. The covering of 200 acres of bottomland hardwoods would have essentially no impact on aquatic primary productivity because these woods are surrounded by old levees and only rarely export detritus to the aquatic system. The area might occasionally be flooded from rainfall and would then have a minor amount of phytoplankton productivity. When the excavated material was placed on it, this primary production would be lost.

(b) Suspension/Filter Feeders. As described earlier, suspension feeders are not abundant in the main channel and those there are adapted to high turbidity. Turbidity caused by channel disposal of excavated material, effluent from the diked disposal area and construction of closure dams and revetments would adversely affect filter feeders downstream during construction. A few organisms would probably be destroyed directly while others would be damaged, but would survive. Recolonization after cessation of dredging would probably be fairly rapid. The small amount of benthic productivity that presently exists in the 200 acres of occasionally flooded forest would be permanently lost.

(c) Sight feeders. Sight feeders common in the channel such as catfish, shad, and buffalo would probably vacate the area during construction.

(4) Actions to Minimize Impacts. The choice of cool-weather months to perform dredging operations would be less stressful on dissolved oxygen supplies. The use of a leveed and diked forest disposal area would prevent adverse suspended particulate-related impacts from the major share of materials dredged for distributary realinements. The establishment of stable dikes of shell or other suitable material before the placement of hydraulic fill to construct the closure dams would effectively curtail the potentials for excessive turbidity and direct losses of fill material to the water

column. The above-mentioned actions would also serve to minimize the destruction of indigenous biota and/or disturbance of their habitats.

d. Contaminant Determinations. Sediment, native water and elutriate analyses of 33, 40, and 12 parameters, respectively, were performed on samples taken from sites along the Atchafalaya River main channel in 1975. Three of the 14 sites are proximate to distributary realinements and closure locations. The sites are identified on Plates 12 and 13 and measured constituent concentrations are listed on Tables G-11-10, G-11-11, and G-11-12. Site 1 (mile 54.3) is between the proposed and existing inlets to Old Atchafalaya River from the Whiskey Bay Pilot Channel; Site 4 is between the proposed and existing East Freshwater Channel inlets, and Site 5 is between the proposed and existing West Access Channel inlets. A fourth site, No. 6, is located about 1.5 miles downstream of the existing East Access Channel inlet. Sediment and water samples were also taken at the existing Old Atchafalaya River inlet, at mile 55, in 1981; chemical analyses of the sediments, water and elutriates are shown on Table G-11-2. Comparisons of the 1975 and 1981 data in the vicinity of the Old Atchafalaya River distributary sites reveal some apparent discrepancies. The copper measured in the sediment sample was 25 mg/kg in 1975 and was only 6.6 mg/kg in 1981, compared to the EPA Region VI proposed criterion of 50 mg/kg. Lead in the 1975 sediment sample was <10 mg/kg, while in 1981 the concentration was 86.3 mg/kg, compared to the Region VI proposed criterion of 50. The 1975 arsenic concentration in the sediment sample was 16 mg/kg, and in 1981 the measurement was 3.32 mg/kg against the Region VI proposed criterion of 5.0. The 1975 detection limit for cadmium in sediment was 10 mg/kg, so its measurement cannot be compared. The 1975 and 1981 elutriate analyses for eight heavy metals showed each to be below the respective EPA freshwater aquatic life chronic criteria by a factor of two or more. Elutriates made from samples taken at sites 4 and 6 in 1975 showed copper levels of 6 and 13 ug/l, respectively (above the EPA criteria of 5.6 ug/l). Corresponding native water (dissolved) copper levels were 3 ug/l at each site. Arsenic was measured at 11, 8, and 9 mg/kg in sediment samples from sites 4, 5, and 6 in 1975, while cadmium was undetectable below 10 mg/kg, thus precluding comparisons.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations are rather sparse in main channels and distributaries and would consist mainly of diatoms, desmids, rotifers, and light-bodied copepods and cladocerans. As discussed earlier in Section 11c.(3)(a), primary productivity would be slightly reduced during and shortly after construction in the main channel and distributaries. Post-project primary productivity in the backwater channels should be higher than for existing conditions. Some zooplankton would be destroyed by the excessively high turbidity during construction, but this effort would be temporary and pre-project plankton levels should be attained soon after cessation of construction.

TABLE G-11-10

BOTTOM SEDIMENT DATA, 1975 SAMPLING, SITES 1, 4, 5, AND 6

Parameter	Site Number 1	4	5	6
Nitrogen, TOT KJD as N (mg/kg)	440	440	2500	3000
COD, (mg/kg)	14,000	38,000	17,000	17,000
Cyanide, (ug/g)	0	0	0	0
Residue Lost on Ignition, (mg/kg)	44,200	55,400	28,500	37,400
Oil and Grease, (mg/kg)	0	0	0	0
Arsenic, (ug/g)	16	11	8	9
Cadmium, (ug/g)	<10	<10	<10	<10
Chromium, (ug/g)	<10	<10	<10	<10
Copper, (ug/g)	25	25	<10	10
Lead, (ug/g)	<10	<10	<10	<10
Mercury, (ug/g)	0.09	0.06	0.07	0.06
Nickel, (ug/g)	10	20	<10	<10
Zinc, (ug/g)	30	50	30	50
Aldrin, Total (ug/kg)	0.0	0.0	0.0	0.0
Chlordane, Total (ug/kg)	0	0	0	0
DDD, Total (ug/kg)	0.0	0.0	0.0	0.0
DDE, Total (ug/kg)	0.0	0.0	0.0	0.0
DDT, Total (ug/kg)	0.0	0.0	0.0	0.0
Diazinon, Total (ug/kg)	0.0	0.0	0.0	0.0
Dieldrin, Total (ug/kg)	0.0	0.0	0.0	0.0
Endrin, Total (ug/kg)	0.0	0.0	0.0	0.0
Eth. Parth, Total (ug/kg)	0.0	0.0	0.0	0.0
Ethion, Total (ug/kg)	0.0	0.0	0.0	0.0
Hept. Epox, Total (ug/kg)	0.0	0.0	0.0	0.0
Heptachlor, Total (ug/kg)	0.0	0.0	0.0	0.0
Lindane, Total (ug/kg)	0.0	0.0	0.0	0.0
Malathion, Total (ug/kg)	0.0	0.0	0.0	0.0
Met. Parth, Total (ug/kg)	0.0	0.0	0.0	0.0
Met. Trith, Total (ug/kg)	0.0	0.0	0.0	0.0
PCB, Total (ug/kg)	0	0	0	0
PCN, Total (ug/kg	0	0	0	0
Toxaphene, Total (ug/kg)	0	0	0	0

TABLE G-11-11

NATIVE WATER DATA, 1975 SAMPLING, SITES 1, 4, 5, AND 6

Parameter	Site Number 1	4	5	6	EPA Aquatic Life Criteria (ug/l)
Nitrogen, Diss. KJD (mg/l)	0.37	0.65	0.45	0.40	
Residue, Suspen. 110C (mg/l)	30	54	26	32	
Residue, Tot. Nonfil, 105C (mg/l)	27	56	36	22	
Residue, Volat, Susp. (mg/l)	2	4	6	0	
Chemical Oxygen Demand (mg/l) (Filter Sample)	11	11	10	8	
Cyanide (mg/l)	0.00	0.00	0.00	0.00	0.0035
Phenols (ug/l)	6	10	6	4	2600
Oil and Grease (mg/l)	2	14	0.0	0.0	
Arsenic, Dissolved (ug/l)	1	1	1	2	40
Cadmium, Dissolved (ug/l)	0	0	0	0	0.025*
Chromium, Dissolved (ug/l)	0	0	0	0	0.29
Copper, Dissolved (ug/l)	5	3	3	3	5.6
Lead, Dissolved (ug/l)	0	0	0	0	3.8*
Mercury, Dissolved (ug/l)	0.1	0.1	0.0	0.0	0.20
Nickel, Dissolved (ug/l)	3	2	3	4	96*
Zinc, Dissolved (ug/l)	10	10	10	10	47
Aldrin, Total (ug/l)	0.00	0.00	0.00	0.00	0.0019**
Chlordane, Total (ug/l)	0.0	0.0	0.0	0.0	0.0043
DDD, Total (ug/l)	0.00	0.00	0.00	0.00	
DDE, Total (ug/l)	0.00	0.00	0.00	0.00	
DDT, Total (ug/l)	0.00	0.00	0.00	0.00	0.0010
Diazinon, Total (ug/l)	0.00	0.12	0.01	0.05	
Dieldrin, Total (ug/l)	0.00	0.00	0.00	0.00	0.0019**
Endrin, Total (ug/l)	0.01	0.01	0.01	0.00	0.0023
Eth. Parth., Total (ug/l)	0.00	0.00	0.00	0.00	
Eth. Trith, Total (ug/l)	0.00	0.00	0.00	0.00	
Ethion, Total (ug/l)	0.00	0.00	0.00	0.00	
Hept. Epox., Total (ug/l)	0.00	0.00	0.00	0.00	
Heptachlor, Total (ug/l)	0.00	0.00	0.00	0.00	0.0038
Lindane, Total (ug/l)	0.00	0.00	0.00	0.00	0.01
Malathion, Total (ug/l)	0.00	0.00	0.00	0.00	0.1
Met. Parth., Total (ug/l)	0.00	0.00	0.00	0.00	
Met. Trith., Total (ug/l)	0.00	0.00	0.00	0.00	
PCB, Total (ug/l)	0.0	0.0	0.0	0.0	0.14
PCN, Total (ug/l)	0.0	0.0	0.0	0.0	
Toxaphene, Total (ug/l)	0	0	0	0	0.013
Silvex, Total (ug/l)	0.00	0.00	0.00	0.00	
2,4-D, Total (ug/l)	0.03	0.20	0.04	0.00	370
2,4-DP, Total (ug/l)	0.00	0.00	0.00	0.00	
2,4,5-T, Total (ug/l)	0.02	0.02	0.03	0.00	

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

** Criteria apply to either parameter or sum of both.

TABLE G-11-12

STANDARD ELUTRIATE DATA, 1975 SAMPLING, SITES 1, 4, 5, AND 6

Parameter	Site Number 1	4	5	6	EPA Aquatic Life Criteria (ug/l)
Nitrogen, Diss. KJD (mg/l)	0.96	3.1	2.9	2.3	
Chemical Oxygen Demand (mg/l) (Filter Sample)	10	23	28	29	
Cyanide (mg/l)	0.00	0.00	0.00	0.00	0.035
Phenols (ug/l)	0	20	17	6	2600
Arsenic, Dissolved (ug/l)	0	2	2	4	40
Cadmium, Dissolved (ug/l)	0	0	0	0	0.025*
Chromium, Dissolved (ug/l)	0	0	1	0	0.29
Copper, Dissolved (ug/l)	3	6	2	13	5.6
Lead, Dissolved (ug/l)	0	0	0	2	3.8*
Mercury, Dissolved (ug/l)	0.1	0.1	0.1	0.1	0.20
Nickel, Dissolved (ug/l)	6	5	0	4	96*
Zinc, Dissolved (ug/l)	10	10	0	10	47

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

(2) Effects on Benthos. Some effects were discussed previously in Section 11a.(4) and 11c.(3)(b). There should be no effects due to the low level of contaminants that might possibly be released by dredging. The quieter, less oxygenated waters between the closure dams and new channels would support a different benthos than exists today and some oxygen problems may develop during low water perids.

(3) Effects on Nekton. As discussed previously in Section 11c.(3)(c), nekton should not be significantly adversely affected by disposal for this feature. If any nekton exists in the temporarily flooded hardwoods, its loss would be insignificant.

(4) Effects on Aquatic Food Web. Disposal in the 200 acres of bottomland hardwoods would have little effect on the aquatic food web because this area makes little contribution at present. Disposal in the main channel, effluent from the diked disposal area, and construction of the closure dams and revetments would have a minor, temporary adverse impact on the aquatic food web by slightly reducing primary and benthic productivity. Primary productivity would increase in the "backwater" portions of the former distributary and benthic productivity might increase if dissolved oxygen problems do not arise.

(5) Effects on Special Aquatic Sites. The only such site that would be directly affected is wetlands. As noted earlier, for purposes of this evaluation, all wooded areas in the basin are considered to be wetlands. The 140 acres of late successional bottomland hardwoods to be utilized as disposal area would revegetate as early successional bottomland hardwoods. The 60 acres to be covered with levees and dikes would remain open land for the life of the project. The wetland values of these areas are minimal at present because the 140 acres are isolated by old levees. The reduction in sedimentation that this feature would engender should help preserve wetland values over large areas of cypress-tupelo swamp and bottomland hardwoods.

(6) Effects on Wildlife. Any wildlife inhabiting the 200 acres of bottomland hardwoods would be affected adversely. Young, slow or weak organisms would be destroyed. Other animals would be forced to relocate on adjacent habitat and might be subjected to inter- or intraspecific population pressures and die or become weakened. These late successional woods are some of the most valuable wildlife habitat in the basin and the early successional species that would replace them would be of less value to wildlife. However, they would be heavily used by certain species--deer during low-water periods and various songbirds during migration. There should be no discernable effect on wildlife due to disposal in the main channel or construction of closure dams.

(7) Effects on Endangered Species. There would be no significant effects. See Appendix H and Section 6, paragraph 6.287 of the EIS for a more detailed discussion.

(8) Actions to Minimize Impacts. See discussion in Sections IIa.(6), IIb.(5), and IIc.(4) above.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. The only toxic contaminant shown to be more concentrated in the elutriate phase than its EPA freshwater aquatic life chronic toxicity criterion is copper. For the lowermost distributary realinement (East Access Channel) a dilution factor of about 1.5 would probably be sufficient to reduce dredged slurry copper levels to less than the EPA criterion in the water column, if the elutriate test is a reliable indicator of the discharged material characteristics. This would be readily achievable in the case of main channel disposal, thus a mixing zone determination would be unnecessary. Although rates of introduction of suspended sediments into the water column at the closure sites are considerably more difficult to predict, nothing in the chemical analyses or the anticipated background conditions suggest that toxic contaminants would be capable of significantly affecting a substantial portion of the water column downstream of any of the closure sites.

(2) Determination of Compliance with Applicable Water Quality Standards. Currently applicable EPA numerical criteria for heavy metals and other parameters in water are shown in Table G-11-13. Current State of Louisiana numerical criteria for applicable waters (Atchafalaya River and Headwaters to mile 118) are shown in Table G-11-6. Qualitative state criteria are shown in Table G-11-6A. The referenced site-specific chemical analyses were compared to the criteria and standards, and notations were made for each measured or suspected violation. As noted above, the high dilution potentials of the receiving water bodies and their favorable background levels of pH, dissolved oxygen and temperature should readily reduce contaminant concentrations below harmful levels in each instance. The presence of elevated turbidity levels immediately adjacent to the dredging and discharge sites would be unavoidable consequences of the activities, but would not represent highly unusual conditions for those water bodies.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No direct or indirect effects on water supplies are expected, since water supplies are not taken from surface waters that would be affected by the proposed discharges.

(b) Effects on Recreational and Commercial Fisheries. No significant impacts to fishery resources would be anticipated.

(c) Effects on Water-Related Recreation. No impact on recreational potentials of the water bodies or their environs would occur. Recreationists coming up the main channel from the south or those crossing the basin would have slightly longer distances to travel once the distributaries are realined.

(d) Esthetics. No esthetic impacts other than those associated with turbidity plumes and noise during construction activities would be anticipated.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. There are no such areas that would be affected by the proposed discharges. There might be unknown archeological sites within the area. Specifications covering the work to be performed in constructing and maintaining this feature would provide for preservation of any items of apparent historical or archeological interest.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The distributary realinements are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000, 332,000, and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent, of these habitat types.

The 200-acre terrestrial habitat alteration caused by the feature considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. The delta area at the river mouth would aggrade slightly more rapidly than at present with fine sand kept out of the swamp areas. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Effects. This project feature should result in lower sediment transport into backswamp areas than would otherwise have occurred. Thus, ecologic impacts of circulation reductions due to excessive siltation would be reduced, if not prevented. The major adverse secondary effects of this feature relate to dredging of the new channels. Approximately 245 acres of late successional bottomland hardwoods, 5 acres of early successional and 10 acres of cypress-tupelo swamp and 22 acres of open water would be converted to channel. Wildlife values on these 260 acres of woodlands would be totally destroyed. Most of these forests are overflowed by the average annual flood and thus would contribute detritus to the aquatic ecosystem as well as provide highly valuable spawning, nursery, and feeding areas for plankton, benthos, and nekton. The newly created distributary habitat would not be as valuable in any of these respects. The present open water habitat to be affected by this feature consists of three "lakes," two of which are remnants of old distributaries. The Blue Hole is presently a deep, clear lake during most of the time, since it rarely receives riverine overflow. Hippy Hole Lake, also deep and clear much of the time, and Sawyer's Cove, a shallow lake, are usually flooded by the average annual flood and thus occasionally receive turbid river waters. All three are presently fairly good fishing areas and their value in this respect would be lost if they were made part of the new distributary channels. Existing benthos in these lakes would be destroyed by dredging and the new benthic populations would be smaller and less diverse. The reduction of sedimentation in backswamp areas would mean that a greater amount of sediment would be available for delta building on Atchafalaya Bay.

III. FINDINGS OF COMPLIANCE FOR DISTRIBUTARY REALINEMENTS.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. The discharge of dredged material from the Old River realinement into the Whiskey Bay Pilot Channel would be environmentally acceptable, but less so than land disposal in the designated confined location, which would not directly affect any water body. No similar land locations exist that are conveniently located to the other realinement sites, and that would not require controlled effluent releases. The potential impacts of open-water disposal in the main channel would be less than those resulting from such releases into smaller bodies, including distributary channels. The alternative East Access Channel realinement route that would utilize Jakes Bayou and connecting channels would require more dredging and produce greater disposal impacts upon woodlands. This route would also be longer and more difficult for navigation than the proposed route. Sediment traps in the realined channels were rejected also, as presenting greater maintenance problems with respect to dredged material disposal. Their effectiveness in improving floodway sedimentation beyond that of the

proposed activity has not been verified. No practicable alternatives exist for disposal of bank grading materials.

c. Temporary and localized dredge-induced turbidity at the realinement sites may violate the State of Louisiana water quality standard for that parameter. Open-water disposal into the main channel would not significantly increase turbidity above ambient levels. Heightened turbidity downstream of the closure construction sites would not occur if the sites were effectively isolated from flowing water by temporary dikes or cofferdams.

d. Reviews of available water quality data collected during both dredging and nondredging periods have shown that dissolved metal concentrations in the Atchafalaya River and other waterways are generally affected only temporarily and locally by hydraulic dredging processes. Prevailing physiochemical conditions do not favor the release of un-ionized ammonia even where sediments have high nutrient levels. Investigations have not revealed any significant concentrations of biologically available pesticides or other synthetic compounds in native water, dredge discharges or elutriate mixtures. Minimum detection limits were well above EPA criteria for several substances, however, so that definite conclusions could not be drawn.

e. The proposed discharges would not impact any endangered species nor their critical habitat.

f. No designated marine sanctuaries are in the project-affected area.

g. The discharges would have no measurable adverse effects on human health and welfare with respect to: municipal or private water supplies; recreational or commercial fisheries; plankton; fish; shellfish; wildlife; or special aquatic sites. Life stages of aquatic life or aquatic ecosystem-dependent wildlife species would not be adversely affected. There would likewise be no significant adverse effects on aquatic ecosystem diversity and productivity that would not be compensated by project-induced ecosystem enhancements. All affected ecosystems would restabilize reasonably soon after construction. Nothing more than temporary adverse effects on recreational esthetic or economic values would result from the dredged material discharges. The construction of this feature should reduce sedimentation in the Atchafalaya Basin Floodway and thus preserve environmental values and improve flood control.

h. Appropriate and practicable steps that have been identified to minimize potential adverse impacts on the aquatic ecosystem include: dike construction along the Old Atchafalaya River realinement; performance at work during moderate flow periods; dikes or cofferdams to separate closure dam construction from direct contact with flowing water; and dredging and disposal during cool-weather months.

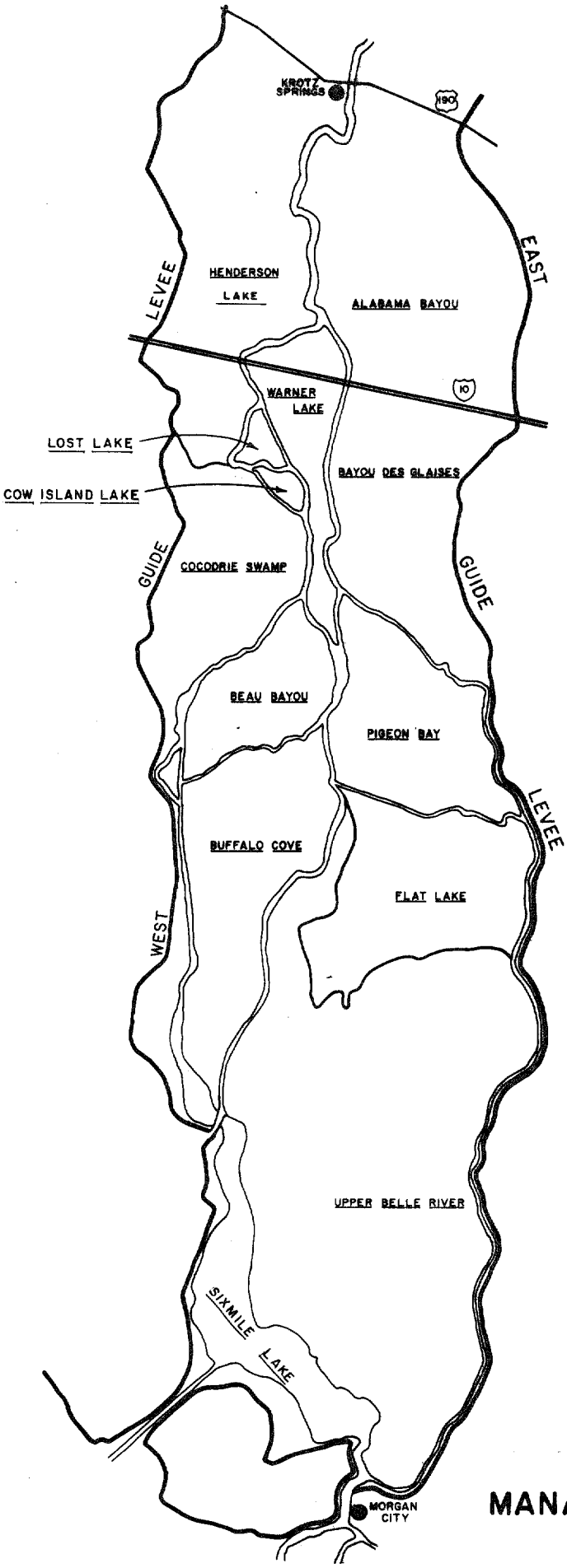
i. On the basis of the guidelines, the proposed disposal sites for the discharge of dredged material are specified as complying with their requirements with the inclusion of the appropriate and practical conditions to minimize pollution and other adverse effects to the affected aquatic ecosystem.

Management Units/Freshwater Structures

I. PROJECT DESCRIPTION.

a. Location. The Atchafalaya Basin is a large, shallow depression lying within the deltaic plain of the Mississippi River in south Louisiana. The boundaries of the study area are the natural levee ridges of the Mississippi River and the abandoned Lafourche distributary on the east, and the natural levee ridges of the old Teche and Cypremort courses of the Mississippi on the west. Natural processes and human actions have combined to produce distinct environmental and hydrological subdivisions within the Lower Atchafalaya Basin Floodway. The hydrologically distinct areas have been identified as management units for purposes of this study. Figure G-11-1 illustrates the thirteen management units identified. This evaluation addresses the two units selected for pilot studies and two freshwater diversion structures associated with hydrologic management in this project.

b. General Description. Thirteen management units were studied to determine their feasibility for restoring historical overflow conditions to benefit the aquatic ecosystem. The Buffalo Cove and Henderson units are proposed as pilot units for initial implementation according to plans developed in conjunction with representatives of US FWS, EPA and appropritae state agencies. The Buffalo Cove area is bordered on the east by the main channel and on the west by Lake Fausse Pointe Cut. Because of the large flow conveyed through the west access channel and Lake Fausse Pointe Cut (15 percent of basin flow), Buffalo Cove is subject to levee-building on both sides. Through the natural levee-building process which has already taken place, and the sediment disposal near the main channel, the eastern side of Buffalo Cove is already becoming a confining levee of the main channel. Along its western edge, particularly in the southwestern portion, water and sediment overflows into Buffalo Cove on a regular basis. In addition, access channels, such as the Si Bon Canal, convey a significant amount of water and sediment into the center of the area. These conditions would subject the entire area of Buffalo Cove to about 5 feet of additional sediment deposition over the next 50 years. Development of management units would require the restriction of their natural outlets by construction of weirs and, in some cases, low-level levees (see Plate G-14). Levees would only be built to raise the perimeter of the unit (where necessary). Construction of new inlets at the upper end of the management unit would also be necessary, as well as the closure of certain bayous and canals, and the improvement of circulation within the unit. Rollovers to provide for small boat access would be installed at bayou and canal closures. The Buffalo Cove unit would be divided into upper and lower areas. The larger upper area would have its inlet at Wanda Canal, and outlets at the south end of Buffalo Cove Lake and in Grand Lake. The



MANAGEMENT UNITS

FIGURE G 11-1

smaller lower area would not have a controlled inlet, but waters would enter through Little Lake Long. The outlet would be just north of Myette Point. Approximately 6 miles of levees would be required for each area. No levees should be required for the Henderson unit. Maintenance would consist of trash and debris removal from inlets and outlets, any necessary levee repairs, and boat rollover maintenance. Also included in the evaluation is the construction of the "Courtableau," and Sherburne freshwater diversion structures to provide freshwater inflow to the Henderson Lake and Alabama Bayou areas, respectively. The "Courtableau" freshwater diversion structure would probably be located at Big Bayou Graw and serve as an inlet for the Henderson management unit area. It would consist of two 10-foot box culverts with invert elevations of 10 feet NGVD designed to pass 3,000 cfs and be located in the west Atchafalaya River levee at approximate mile 44.5. The Sherburne freshwater diversion structure, which would also include two 10-foot box culverts with invert elevations of 10 feet NGVD designed to pass 3,000 cfs, would be located in the east Atchafalaya River levee at mile 43. Maintenance of both structures would consist of periodic inspection, removal of accumulated debris, and any repairs needed.

c. Authority and Purpose. The freshwater diversion structures are authorized by the Flood Control Act of 15 May 1928, Public Law 291-70, as amended. Study of the management units was authorized by resolutions by both the US Senate and House Committees on Public Works, 23 March 1972 and 14 June 1972, respectively, to develop a comprehensive plan for the preservation and management of the water and land resources of the Atchafalaya Basin. By letter dated 18 June 1976, the Director of Civil Works of the Office of the Chief of Engineers directed the President of the Mississippi River Commission to address both the previously authorized features of the Atchafalaya Basin Floodway project and potential features for resource preservation and management, effectively combining studies of the Atchafalaya Basin Floodway project with those previously mandated by Congress. The accompanying report and EIS seek Congressional authorization to construct the two pilot management units. The purpose of the management units and diversion structures is to attempt to restore historical overflow patterns as much as possible, and to encourage water movement through the units. This feature might also restrict sediment movement and deposition while increasing the amount of nutrient and organic matter supplied to the estuarine area and the Gulf of Mexico.

d. General Description of Dredged and Fill Material. The main dredged and fill material considerations for the Buffalo Cove management unit are: excavation for the Alligator Bayou inlet structure and channel; excavation for two outlet structures and channels along Grand Lake and one at the lower end of Buffalo Cove Lake; levee building to supplement low natural ridges (below average annual flood level) in the lower reaches along Grand Lake; the cutting of gaps through dredged material banks of canals impacting water circulation (Florida

Gas Canal, Wanda Canal, and Si Bon Canal); channel closures at various locations; and excavation for a small boat access canal. The Henderson management unit's structural features would be primarily limited to inlet channel excavation for conveyance of main channel flows through and downstream of the Courtableau freshwater diversion structure. Some gaps might be cut through channel banks to increase circulation within the unit. Detailed plans for the other management units would be prepared in the future. Construction of diversion structures would also involve excavation of inlet channels and placement of fill material.

(1) General Characteristics of Material. The material is generally deltaic deposits overlaying backswamp clays. A soil sample taken at the proposed Wanda Canal inlet site consisted of 65 percent sand, 27 percent silt, and 8 percent clay. Other samples were obtained at the Henderson unit outlet location on the WABPL Burrow Pit, and at an alternate site for the Courtableau unit (West Atchafalaya River levee at mile 48). The sand-silt-clay ratios were 6-37-57 and 58-38-4, respectively.

(2) Quantities of Material. Quantities are tentative for the Buffalo Cove unit, but are presently estimated at about 700,000 cubic yards for all dredging works. The total quantity of material estimated to be dredged in the Henderson unit is unknown but would probably be less than that dredged for the Buffalo Cove unit. Quantities associated with construction of the two diversion structures are unknown.

(3) Sources of Material and Disposal Methods. Material would be excavated by dragline directly from the Courtableau and Sherburne inlets, Alligator Bayou, Lake Fausse Point Cut, distributary channel and canal banks, and from the sites of the outlet structures and channels along Grand Lake (natural levees). Disposal would be by casting onto nearby land areas. The levees would be cast from the adjacent channel. Closures would be made using material from the nearest suitable dry land borrow sources.

e. Description of Proposed Discharge Sites.

(1) Locations. Locations of the proposed discharge sites for the Buffalo Cove unit are shown on Plate G-14. Discharge of dredged or fill material would occur at most features indicated on the plate. Locations of the proposed Courtableau and Sherburne freshwater diversion sites are shown on Plates 15 and 16, respectively. Other possible disposal sites for the Henderson unit are unknown at this time.

(2) Types of Sites. Construction of most features for the management units would be unconfined disposal on adjacent land. Canal closures would require open water disposal. Excavated material from

the Courtableau and Sherburne diversion structure sites would be disposed on diked land areas near the sites.

(3) Sizes of Sites and Types of Habitat. This information is indicated in Table G-11-13.

TABLE G-11-13

SIZES OF DISPOSAL SITES AND TYPES OF HABITAT FOR MANAGEMENT UNITS AND FRESHWATER STRUCTURES

Site Location	Number of Acres[1/]	Habitat Type
Sherburne Freshwater Diversion Structure Inlet	25	BLHW[2/]
"Courtableau" Freshwater Diversion Structure Inlet	2	BLHW
Wanda Canal Inlet	<5	ES[3/], B[4/]
Bayou Eugene Closure and Boat Rollover	1	ES, B[5/]
Gap Cutting in Florida Gas and Wanda Canals	<10	ES, CT[6/], B
Si Bon Canal Closure and Boat Rollover	1	ES, R
Gap Cutting in Si Bon Canal	<10	ES, CT, B
Bayou Gravenburg Boat Rollover	1	ES, B
Buffalo Cove Outlet Structure	<5	ES, R
Little Lake Long Boat Launch and Access Canal	2	ES, B
Grand Lake Outlet Structure	5	ES, R
Taylor Point Closure	1	ES, R
Myette Point Outlet Structure	10	ES, R
Levee for Upper Buffalo Cove Unit	100	ES, R
Levee for Lower Buffalo Cove Unit	100	ES, R

1/ Acreage is conservative estimate, actual plans for many features have not been finalized.

2/ BLHW = mid-to-late successional bottomland hardwoods.

3/ ES = early successional bottomland hardwoods.

4/ R = river and distributary.

5/ B = bayou and canal.

6/ CT = cypress-tupelo

f. Description of Disposal Method. Disposal would be by dragline.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. Levees would be IV on 3H slopes with elevations designed to allow bi-annual overbank flooding. Closures would also allow bi-annual overbank flooding.

(2) Effects on Sediment Type. Levee embankment and closure material would be obtained from adjacent areas and so would be of similar type. Some riprap and other stone would be imported to the area for use in constructing the diversion structures, and inlets and outlets to the Buffalo Cove management unit. Material from gap cutting would be old disposal and therefore similar to the area in which it would be placed.

(3) Effects on Dredged/Fill Material Movement. Slight movement and leaching would occur during normal storm events. No noticeable impact would be expected.

(4) Physical Effects on Benthos. Land-based disposal from the freshwater structures would reduce benthic use of the late successional bottomland hardwoods. Construction of inlet and outlet structures and closures for Buffalo Cove would destroy any benthos in the immediate area. Disposal of material from gap cutting and construction of the Little Long access canal would destroy existing benthos in the disposal areas and reduce future benthic usage. The covering of 200 acres of seasonally-flooded early successional bottomland hardwoods by levee building would destroy the existing benthos and reduce the future use of these acres by benthic organisms.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. No effects would occur.

(b) Water Chemistry. No substantive effects would occur.

(c) Clarity. During excavation, construction, and dredging operations, water clarity in adjacent wetlands or water bodies would be significantly reduced. This condition would be temporary and would rapidly return to normal following project operations.

(d) Color. Water color would be affected similarly to water clarity.

(e) Odor and Taste. No effects would occur.

(f) Dissolved Gas Levels. The dissolved gas of major concern is oxygen. Oxygen levels are generally dependent on flow conditions and temperature in the wetland areas of the Atchafalaya region. Low levels occur in the warm summer months. The circulation increase achieved by the management units and diversion structures would serve to improve oxygen conditions. A full discussion on oxygen effects appears in Section II.c.(2)(b).

(g) Eutrophication. Small increases in the nutrients would not be expected to induce significant eutrophication.

(h) Nutrients. Nutrients in Atchafalaya wetland areas are at generally low levels. Primary production is dependent to a large degree on the recycling of nutrients by bacterial action. Nutrient levels generally decrease as a function of distance away from the major waterways. By improving the circulation with management units and diversion structures, nutrients would be increased in the Henderson and Buffalo Cove areas. The Sherburne diversion structure would positively affect nutrient levels in the Alabama Bayou area.

(2) Effects on Current Patterns and Circulation.

(a) Current Patterns. Construction of the Sherburne structure would alter existing current patterns, allowing more water to flow in Alabama Bayou, Little Alabama Bayou, and Bayou des Glaises. Construction of the Courtableau structure would increase the flow-through in the Henderson unit with more water in Big Bayou Graw, Bayou Fordoche and other waterbodies in the southern portion of the unit. Work in the Buffalo Cove area would reconnect the Wanda Canal to the West Access Channel to bring water in at the north end of the unit. Closure of the Si Bon Canal at Lake Fausse Pointe Cut should reverse flow in the canal and allow it to flow south and west. Bayous Gravenburg and Eugene would have more flow than at present. The outlets at Buffalo Cove Lake and in Grand Lake in conjunction with the levee would prevent rapid drainage of the Buffalo Cove-Mud Lakes area. Flow through Buffalo Cove Lake would be in a southerly direction most of the year. Construction of the levee for the lower Buffalo Cove unit, the Taylor Pointe closure, and the Myette Point outlet would prevent flow from the channel through Grand Lake from entering the southern portion of Grand Lake. Construction of these two units could help prevent some bayous and lakes from draining during low water.

(b) Velocity. Higher velocities would be expected in the upper and middle portions of the Buffalo Cove unit, all portions of the Henderson unit and all areas affected by the Sherburne structure. Constriction of outlet flows might decrease velocities in the southern portion of the Buffalo Cove unit. This decrease in velocity might cause channel configuration to be shallower and more uniform.

(c) Stratification. There would be no stratification effects.

(d) Hydrologic Regime. The whole purpose of management unit and diversion structure construction is to restore the hydrologic regime to mimic as closely as possible historical natural water overflow patterns. Construction of management units could reduce by as much as half the amounts of water flowing through the units each year; however, they would allow more water retention than would occur under without-project conditions.

(3) Normal Water Level Fluctuations. The purpose of management units would be to maintain water levels in the unit as they were in 1965. Desired hydrographs were prepared for each unit; these attempted to reproduce the 1965 water year (see Section 6 of this appendix for methodology). In the short-term, management units would slightly increase the peaks of flooding for the first decade of project life. Studies indicate that neither the Henderson nor Buffalo Cove units could preserve present water levels, which are lower than the 1965 levels. However, compared to future without-project conditions, management units would, on the average, experience given flooding levels an average of 3 to 4 weeks longer from mid-March to mid-May and 2 months longer from January through July. Management units would reduce the degree of short-term water level fluctuations within each unit (see Figure 6-1 in the EIS). The amounts of water entering lower management units would be reduced and therefore current velocities would also be reduced.

(4) Salinity Gradients. Not applicable in this area.

(5) Actions That Will Be Taken to Minimize Impacts. Overall, this project would have positive environmental impacts. Precautions to minimize disruption during implementation of the project would be taken.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. Suspended particulates and turbidity would increase substantially in the vicinity of each construction or excavation operation. This condition would be temporary, rapidly returning to normal following completion of the work. Changes in water patterns might affect long-term suspended particulate and turbidity levels, however, adjustment up or down would not be expected to be noticeable.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Most excavation and placement work for the inlets, outlets, closures, and levees of the Buffalo Cove and Henderson management units and the Sherburne structure would be accomplished in water bodies which generally have moderate to swift water movement. Light penetration would be reduced in these waters as a result of the proposed construction activities. Coarse solids lost to water bodies and wetlands should settle from suspension readily. Finely divided and colloidal materials lost to the waters and wetlands may cause longer periods of high turbidity. The screening and filtering action of vegetation in some of the wetland areas might help to limit the water column effects of increased suspended solids and turbidity levels.

(b) Dissolved Oxygen. Dissolved-oxygen concentrations are of primary importance in the Atchafalaya River Basin. Fish and other aquatic life require adequate levels of dissolved oxygen for egg and larval development and normal growth and activity. There is no specific dissolved-oxygen concentration that is favorable to all species and ecosystems. However, low dissolved-oxygen concentrations are unfavorable to almost all aquatic organisms. The principal source of oxygen in the Atchafalaya River Basin is reareation of the water from atmospheric oxygen. The solubility of oxygen in water is inversely related to temperature. As the temperature of the water increases, the amount of atmospheric oxygen the water is capable of holding decreases. Oxygen also is produced in some areas of the basin as a byproduct of photosynthesis. Dissolved-oxygen concentrations in off-channel portions of the management units and the Alabama Bayou area are generally dependent upon temperature and flow conditions. During periods of high flow a sufficient supply of freshwater reaches these areas and dissolved-oxygen concentrations are maintained at a high level. During the low-flow summer months smaller quantities of water reach these areas. Dissolved-oxygen concentrations decline to low levels in some swamp areas during the spring because of the increased effect of organic degradation and the lack of a sufficient supply of oxygen from the river or from photosynthetic production. Backswamp areas which are presently subject to low dissolved oxygen conditions in the spring high water season could experience worsened oxygen problems within the management units, especially if inflowing waters do not circulate to all parts of the unit. This could occur, for example, by short-circuiting or impedence of water circulation caused by the creation of dredged material embankments during canal dredging by the oil and gas industry. Implementation of management units and diversion structures would lower dissolved oxygen levels during the construction phase, but would exert a long-term positive effect by improving circulation.

(c) Toxic Metals and Organics. The Atchafalaya River Basin would not be expected to harbor significant amounts of toxic

substances. A sampling program conducted by the New Orleans District Corps of Engineers in 1981 included two samples in the Henderson area and one sample in the Buffalo Cove area. Tables G-11-14 through G-11-16 list the results of chemical analyses of water, sediment and elutriates from the three sites. The elutriate tests (indicatative of the composition of dredged slurry material released from a hydraulic dredge pipeline) did not reveal any significant releases of toxicants, although some parameters were not measurable at EPA criteria levels. For this reason, pesticide analyses (not shown) were generally inconclusive.

(d) Pathogens. No effect as a result of proposed construction or excavation operations.

(e) Esthetics. Temporarily high turbidity levels may detract from esthetic appeal during construction and excavation. The boost in aquatic productivity in these areas should positively affect long-term esthetics.

(3) Effects on Biota. The impacts of management units per se are discussed in Section II.e. following.

(a) Primary Production. The turbidity engendered by disposal for these features would slightly reduce primary productivity during the construction periods and for a short-time thereafter. This impact would not be significant in this turbid water ecosystem that is mainly detritus-driven.

(b) Suspension/Filter Feeders. Construction would cause temporary turbidity which would have a slight adverse impact on suspension/filter feeders. Some would be directly destroyed and others would be weakened and eventually die. However, repopulation should occur fairly quickly upon cessation of dredging.

(c) Sight Feeders. The temporary turbidity caused by construction would cause sight feeding fish and crawfish to move to adjacent clearer areas; thus there would be essentially no impact.

(4) Actions Taken to Minimize Impacts. This feature would have positive environmental impacts. Attempts would be made to minimize turbidity during construction.

d. Contaminant Determinations. Due to the lack of significant industrial, municipal, or agricultural pollution sources in the Atchafalaya Basin, native soils are considered unlikely to contain substantial contaminant amounts. Several samples were taken within the two proposed management units. The analyses and implications were discussed earlier in Section II.c.(2)(c). No significant contamination would be expected due to the proposed project actions.

TABLE G-11-14

WATER AND SEDIMENT DATA
SITE NO. 4, 1981 SAMPLING
BAYOU COURTABLEAU

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					65.4
Total Volatile Solids					1.48
Turbidity	4,000				
Suspended Solids	26,300				
Volatile Suspended Solids	8,600				
Oil and Grease					271
Chlorides	30,000				
COD	22,000	16,000	22,000		29,700
TKN	640		1,360		323
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	< 10		< 10		< 0.20
Nitrate-N	129		122		< 0.20
Total Nitrogen-N	770		1,480		323
Ammonia-N	10		704	20**	15.1
OrthoPhosphate-P	11	< 10	< 10		0.86
Total Phosphorus-P	< 100	< 100	< 100		345
Calcium	59,000	59,500	56,600		
Magnesium	16,200	16,600	14,600		
Manganese	191	2	1,300		296
Iron	266	30	< 25	1,000	6,230
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	1	2	< 1	3.8*	80.9
Zinc	266	< 25	< 25	47	24.2
Chromium	< 1	1	< 1	0.29	7.35
Cadmium	< 0.1	0.1	< 0.1	0.025*	0.33
Copper	1	1	1	5.6	2.98
Nickel	18	< 1	< 1	96*	9.13
Arsenic	2	2	1	40	3.87

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

TABLE G-11-15

WATER AND SEDIMENT DATA
SITE NO. 6B, 1981 SAMPLING
FLOODSIDE BORROW PIT NEAR HENDERSON CONTROL STRUCTURE

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					50.3
Total Volatile Solids					3.31
Turbidity	41,000				
Suspended Solids	44,000				
Volatile Suspended Solids	21,400				
Oil and Grease					192
Chlorides	45,000				
COD	28,000	22,000	19,000		55,800
TKN	950		1,720		871
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	11		30		< 0.20
Nitrate-N	433		260		< 0.20
Total Nitrogen-N	1,390		2,010		871
Ammonia-N	38		1,000	20**	45.8
OrthoPhosphate-P	62	< 10	< 10		0.860
Total Phosphorus-P	140	< 100	< 100		793
Calcium	22,100	22,500	24,800		
Magnesium	8,050	8,310	8,010		
Manganese	70	6	1,100		935
Iron	2,720	31	62	1,000	25,000
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	< 1	1	< 1	3.8*	196
Zinc	< 25	< 25	< 25	47	89.2
Chromium	< 1	< 1	< 1	0.29	24.4
Cadmium	0.6	0.2	< 0.1	0.025*	0.71
Copper	4	2	3	5.6	24.8
Nickel	2	3	< 1	96*	30.6
Arsenic	2	< 1	2	40	7.69

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticpated pH and temperature conditions.

TABLE G-11-16

WATER AND SEDIMENT DATA
SITE NO. 13, 1981 SAMPLING
WEST ACCESS CHANNEL AT WANDA CANAL

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					73.1
Total Volatile Solids					1.11
Turbidity	34,000				
Suspended Solids	56,500				
Volatile Suspended Solids	14,400				
Oil and Grease					375
Chlorides	30,000				
COD	11,000	7,000	20,000		9,060
TKN	710		980		176
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	35		45		< 0.20
Nitrate-N	1,520		1,430		< 0.20
Total Nitrogen-N	2,270		2,460		176
Ammonia-N	450		448	20**	6.70
OrthoPhosphate-P	71	270	13		3.11
Total Phosphorus-P	160	< 100	< 100		374
Calcium	40,000	38,100	48,100		
Magnesium	11,700	10,900	13,900		
Manganese	91	18	1,490		335
Iron	2,430	110	< 25	1,000	10,800
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	3	1	< 1	3.8*	88.6
Zinc	< 25	< 25	< 25	47	41.6
Chromium	3	< 1	< 1	0.29	13.8
Cadmium	0.6	0.3	< 0.1	0.025*	0.24
Copper	4	4	6	5.6	7.28
Nickel	< 1	< 1	1	96*	15.7
Arsenic	2	1	1	40	3.96

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations in the swamps and lakes to be beneficially impacted by these features are generally quite rich and diverse. Zooplankton populations in the basin are generally divided into two recurrent groups: those associated with riverine waters and those connected with all other habitat types (bayous, lakes, and swamps). Common genera within management units would include ostracods, heavy bodied cladocerans, and copepods. Phytoplankton populations would be high in lakes during the low-water periods when turbidity is decreased. Typical groups would be diatoms, bluegreens, greens, and flagellates. Temporary turbidity would slightly reduce plankton populations. The overall impact of construction of management units would be to increase primary and detrital productivity by preserving more aquatic habitat than would exist under without-project conditions. The increased amount of aquatic habitat would allow greater numbers of zooplankton to be produced within management units.

(2) Effects on Benthos. Lakes are only moderately productive habitat in terms of numbers, but show great species diversity. The most common organisms are crawfish, snails, midges, and tubificid worms. Swamps, with their rich detrital substrate, are the most productive benthic habitat in the basin. Swamps appear to act as a benthic "reservoir"; the benthic organisms are flushed out of the swamps into other habitats by floodwaters. Clams, fly larvae, and isopods are the most abundant organisms. By preserving more aquatic habitat and increasing flooding over without-project conditions, management units would preserve the numbers and diversity of benthic organisms. The habitats that would be improved by management units are those that are important for benthos, such as: lakes, with the mean number of aquatic organisms per square meter being 1,800; bayous, with 3,300; and swamps, with 3,800.

(3) Effects on Nekton. Lakes are fairly productive fishery habitat, with the most common species being shad, mullet, bowfin, gar, and numerous sunfish (Grand Lake had a sport fish standing crop of 135 pounds per acre in 1977). Swamps are less valuable than lakes as fishery habitat, but they provide spawning and nursery areas. Bottomland hardwoods also provide valuable fishery habitat when flooded. Temporary turbidity would cause only an insignificant impact on fish. The ultimate result of management units would be to increase fishery productivity by several means. Retaining higher water levels in units would prevent delay in production of juvenile crawfish and cannibalism of young in burrows. By keeping forests flooded for additional time, small fish would be able to stay longer in this nursery area and would therefore be larger and more able to escape predators as their habitat became restricted by falling water levels. Management units would preserve aquatic habitat in the summer, and these areas would become available for fish as higher temperatures

made shallower areas uninhabitable. Units would flood more forestland than would be flooded under future without-project conditions. Flooding these forests would increase the amount of detritus available to the system and, thereby, increase fishery productivity.

(4) Effects on the Aquatic Food Web. At present, the flooding and dewatering of the basin plays a vital role in the cycles of distribution of phytoplankton, zooplankton, and benthos throughout the system. The restriction of flow caused by management units may slow these cycles. However, compared to future without-project conditions, construction of management units would preserve the cycles as the basin dries out. This restriction of flow would probably reduce the amount of organic matter exported to the system downstream. Studies have shown a positive correlation between organic matter export and runoff for several watersheds. Thus, management units would probably reduce export compared to the present, but would provide more export than would occur under future without-project conditions. Thus, on balance, management units would be beneficial to the aquatic ecosystem by improving planktonic, detrital, benthic and nektonic productivity, and by increasing the amount and quality of available aquatic habitat. In Buffalo Cove where future water levels might be temporarily higher than exist at present, ground cover might be reduced, and the loss of this potential detritus could slightly decrease fishery productivity.

(5) Effects on Special Aquatic Sites.

(a) Wildlife Management Areas. The Buffalo Cove management unit would include approximately one-third of the Attakapas Wildlife Management Area. Construction would cause temporary turbidity, but the management unit would improve aquatic productivity in the area.

(b) Wetlands. As noted earlier, for purposes of this evaluation, all habitats found in the proposed disposal areas (cypress-tupelo, mid-to-late successional bottomland hardwoods, and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would permanently remove approximately 250 acres of woodlands from production, either by construction of inlet and outlet structures, levees, or an access canal. Approximately 20 acres would be impacted by gap cutting. These areas would revegetate with early successional bottomland hardwoods. Overall, construction of management units and freshwater structures would improve wetland values in the affected areas.

(6) Effects on Wildlife and Forests. Construction of management units would have varied impacts on bottomland hardwood forests. Some reports indicate that increased flooding had caused increased mast production and tree growth. Other studies show that flooding that extended into the growing season resulted in seed

destruction. In the basin, it appears that the existing water regime is changing the species composition of hardwood stands by favoring those low-value species that break dormancy late or are highly water tolerant such as bitter pecan and swamp privit. Corps of Engineers studies indicate that in the Henderson unit approximately 2,000 acres of late successional bottomland hardwoods would be flooded until 15 July if a management unit were implemented. With no management units, far fewer acres would be flooded. The flooding caused by management units as opposed to without-project conditions would reduce potential ground cover and understory production and thus decrease the amount of available wildlife food. The extra flooding that would occur for the first decades of project life with management units would probably benefit timber growth. The Buffalo Cove unit, by attempting to maintain current water levels, would insure that portions of the basin remain cypress-tupelo instead of converting to a mixture of bottomland hardwoods--approximately 2,000 acres could be so preserved. The reduction in short-term water level fluctuations combined with reduced flows could adversely affect timber growth and reproduction in cypress-tupelo areas. A more detailed discussion of impacts to forests is contained in the final EIS, paragraphs 6.17 and 6.27. The low-quality hardwoods that might replace the present moderate- to high-quality hardwoods because of increased flooding in management units could reduce wildlife in the basin. The decreased ground cover and understory would also have an adverse impact on wildlife populations. The filling of the wetlands discussed above would drive the indigenous wildlife away and some might die due to increased competition on adjacent lands. Young or slow-moving animals would be directly destroyed.

(7) Endangered and Threatened Species Effects. This feature would have no adverse impact on endangered or threatened species nor on critical habitat.

(8) Actions to Minimize Impacts. Attempts would be made to minimize impacts on fish and wildlife habitat during construction.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. In view of the limited possibility of contamination, mixing zone calculations would not be necessary. Variable discharge, unknown quantities of dredged or fill material required, and indefinite chemical analyses would impair determining the mixing zones anyway. Qualitatively, it would be expected that turbidity levels would be high during the construction phase, but would return to near normal soon afterward.

(2) Determination of Compliance with Applicable Water Quality Standards. Water quality standards are established at the state level. Louisiana standards include a limited number of parameters which in general do not reflect industrial pollution (chloride,

sulfate, dissolved-oxygen, pH, coliform bacteria, temperature, and total dissolved solids). With the possible exception of dissolved-oxygen, none of these standards would be violated. In general, the proposed action would improve existing water quality conditions.

(3) Potential Effects of Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects would be expected.

(b) Effects on Recreational and Commercial Fisheries. Impacts on fisheries were discussed in Section IIe.(3) above. Filling of forested wetlands would remove habitat for sport and commercial fish as well as destroy the detritus these areas furnish to fuel the aquatic ecosystem. However, construction and operation of the management units would mitigate these losses to fisheries.

(c) Effects on Water-Related Recreation. The minor loss of wetlands caused by construction of management units would have little impact on water-based recreation. As discussed in the final EIS in paragraph 6.290, habitat losses would not preclude future recreational use, based on an analysis of existing and proposed boat-launching access. The channel closures and weirs proposed as part of the management units would hinder boat access into the units. Rollovers for small boats would be provided. Attempts to maintain present water levels in the management units would benefit local residents and recreationists that depend upon the aquatic productivity of these resources for their livelihood or enjoyment.

(d) Esthetics. No significant effects.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Approximately one-third of the Attakapas Wildlife Management Area is located in the Buffalo Cove unit. The unit should improve aquatic productivity in this area. There might be unknown archeological sites within this area. Specifications covering the work to be performed in constructing and maintaining the project features would provide for the preservation of any items of apparent historical or archeological interest.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The management units and freshwater diversion structures are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife and other natural resources of the basin. Overall, then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through

environmental easements. The plan cannot, however, prevent large-scale changes in the habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-late successional bottomland hardwoods, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000, 332,000, and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent of these habitat types. The terrestrial habitat loss caused by the two features considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. Also, these features provide many of the environmental benefits of this project. They would retard the inevitable degradation of the aquatic environment that would occur under without-project conditions. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Impacts. Secondary impacts of these features include the benthos that would be destroyed during constructin of the levees and access canal for the Buffalo Cove unit. Management units, in combination with the sediment control features, would limit slightly the amount of sedimentation occurring in backswamp areas and help to preserve the depth and extent of existing aquatic areas. These features would have a limited efficiency with management units contributing very little, and appreciable sedimentation within the management units would still be expected to occur.

III. FINDINGS OF COMPLIANCE FOR MANAGEMENT UNITS.

a. No significant adaptations of the guidelines were necessary for this evaluation.

b. An alternative to the previously described management unit concept was a plan by which each unit would have controlled inlets and outlets, navigation locks, and pumping stations. This alternative was eliminated from further consideration because preliminary estimates indicated that construction, operation and maintenance costs would be far greater than with other alternatives. No alternative disposal method or site is under consideration, since little adverse impact is expected under the selected plan.

c. Each of the work items listed in Section I.d. would likely cause a noticeable rise in turbidity levels in the immediate vicinity of the work site. These levels would return to normal soon after

construction was complete. Since no numerical standards exist for turbidity or suspended sediment, a mixing zone could not be defined for these parameters. On a qualitative basis, no violations would be expected. There is no evidence from available data that any other regulated parameter would occupy a large enough portion of the water column to inhibit movements of free-swimming and drifting organisms. On the basis of available data, there would be no significant violations of applicable State of Louisiana water quality standards associated with implementation of this project feature.

d. No violations of the Toxic Effluent Standards of Section 307 of the Clean Water Act would be expected.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of any critical habitat.

f. No designated marine sanctuaries are in the project area.

g. The proposed disposal of dredged material would not result in significant adverse effects on aspects of human health and welfare such as: municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, and the above-mentioned special aquatic sites. There would be no significant adverse effects on life stages of aquatic animals or other wildlife dependent on aquatic ecosystems. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability would not occur. Recreational, esthetic, and economic values would not be adversely impacted in a significant manner. On the whole, environmental values would be enriched.

h. Appropriate and practical steps taken to minimize potential adverse impacts of the discharge of material into aquatic ecosystems include using only those areas of wetlands necessary for project completion.

i. On the basis of the guidelines, the proposed disposal sites for the discharge of fill material are generally specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

Channel Training WLO and LAR

I. PROJECT DESCRIPTION.

a. Location. The Atchafalaya Basin is a large, shallow depression lying within the deltaic plain of the Mississippi River in south Louisiana bounded on the south by the natural levee ridge of the old Teche course of the Mississippi (see Plate G-1). The Basin is drained by two outlets. The Lower Atchafalaya River (LAR) is a natural outlet with a design capacity of 1,200,000 cubic feet per second (cfs). It begins near Morgan City and flows southward to Atchafalaya Bay, a distance of 20 miles. Wax Lake Outlet (WLO) is a 16-mile dredged channel with a capacity of 300,000 cfs located 10 miles west of Morgan City. It extends from Sixmile Lake through the Teche Ridge to Atchafalaya Bay.

b. General Description. Channel training below Morgan City is a process that consists of dredging material from the channel and placing it in shallow water and marsh areas along the bank in intermittent mounds built to a grade to equal the average annual flood. These works would simulate the development of natural ridges. Once in place, the training works would confine more flow to the channel, which would not only tend to accelerate its development, but also reduce the overbank deposition occurring during the project life. These works, generally built along both banks of the LAR and WLO gulfward of the Gulf Intracoastal Waterway (GIWW), would not be completely confining. Gaps would be left between disposal areas to allow for some continued development of the overbank marshes. In addition, Bayou Shaffer would be closed near its junction with the GIWW. A 4-foot diameter pipe would be placed in the closure to allow some low water flows. The project flowlines for the final array of plans represent conditions 50 years in the future. Such projections must be based on subjective evaluations of future development. All studies of the Atchafalaya River to date have concluded that the delta will continue to move farther into the bay. As this occurs, it is assumed that what can be done above the mouth to help improve flow in the river now would also be applicable above the mouth of the river in the future. It is therefore possible that conditions would merit continuance of the channel training program as the mouth of the Atchafalaya River moves gulfward with time because of continued delta development. If this were to occur, an EIS supplement and a supplemental Section 404(b)(1) Evaluation would be prepared.

c. Authority and Purpose. This feature was authorized by the Flood Control Act of 1928, as amended by subsequent authorizations. Senate and House resolutions in 1972 authorized development of a comprehensive plan for preservation and management of water and land resources in the Atchafalaya Basin. In 1976, the Chief of Engineers authorized a post-authorization study to address alternate plans to

accomplish authorized purposes of the Atchafalaya Basin Floodway project. The attached Main Report recommends that the Chief of Engineers approve implementation of this feature. Two major changes are occurring in the outlets to the Basin. The WLO is enlarging rapidly and capturing a larger and larger percentage of the combined outlet flow. It is expected to grow from its present 38,000 square feet (sf) cross section to 51,000 sf by 2030, and to capture 50 percent of the combined flow, if no actions are taken. On the other hand, the LAR is diminishing in cross section and could have a cross section of 47,000 sf by 2030 (compared to its present section of 69,000 sf). The LAR is filling more rapidly than the WLO is growing, so the combined outlet capacity is decreasing. The design capacity is 1,500,000 cfs; the present capacity is only 850,000 cfs and it will decrease further under without-project conditions. The outlet flow distribution control described earlier would prevent capture of the LAR by the WLO and would cause some increase in outlet capacity. The channel training features would also increase outlet capacity. The channel training works would also reduce the project flood flowline at Morgan City by about one foot.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. The channel training material would be predominantly sand with varying proportions of silt and clay. The Bayou Shaffer closure material would be hydraulic clay fill, having low plasticity and permeability.

(2) Quantity of Material. It is estimated that 4.7 million cubic yards of material would be required for the training works. The Bayou Shaffer closure would require about 650,000 cubic yards of unconfined fill material.

(3) Source of Material and Disposal Methods. The channel training material would be hydraulically dredged from the adjacent channels. Bayou Shaffer would be closed using hydraulic clay material from a nearby, but currently undesignated, source.

e. Description of Proposed Discharge Sites.

(1) Location (map) Plates G-17 to G-19 illustrate the location of the disposal mounds and the Bayou Shaffer closure.

(2) Size of Disposal Areas and Types of Habitat. Construction of the channel training works would require the dredging of approximately 31 miles along the banks of the WLO and LAR. The acreages of disposal sites are indicated in Table G-11-17. The closure at Bayou Shaffer would cover less than 10 acres.

(3) Type of Site (confined, unconfined, open water). The discharged dredged material for channel training would not be confined either for the channel training works or for the Bayou Shaffer

closure. Each mound of material for channel training would gradually spread to cover an estimated 18 acres. The hydraulic material for the Bayou Shaffer closure would be placed in open water in an unconfined state unless soil tests indicated potential for significant erosion of the submerged material.

(4) Timing and Duration of Discharge. Construction of channel training works would take approximately 12 months and be done during the low water period. The initial filling of Bayou Shaffer would require about 6 weeks, during moderate to low water. After periods of about three and four years following original placement, the closure would be shaped to interim and final cross sections by dragline.

TABLE G-11-17
HABITAT TYPE OF DISPOSAL AREAS

Location	Miles of Dredging	Habitat Type of Disposal Area			
		Cypress-Tupelo	Early Successional Bottomland Hardwoods	Fresh Marsh	River (Shallow shore)
East Bank LAR	8	320	380		100
West Bank LAR	15	380	500	160	350
East Bank WLO	4		240		160
West Bank WLO	4		300		100
TOTAL	31	700	1420	160	710

f. Description of Disposal Method. Construction of channel training works would be accomplished by using a hydraulic dredge to pump material from the existing channel bottom areas into adjacent shallow water bottoms or stream banks. The Bayou Shaffer closure would also use a hydraulic dredge. The crown portion of the hydraulically placed closure section would be shaped after the initial fill had been in place for about 3 years. The shape-up would be in two stages, consisting of an initial dragline shaping followed by a final dragline shaping about one year later.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. For channel training, the pumped material would be allowed to spread freely to the angle of repose, estimated to be one vertical on 40 horizontal. The elevation of the placed material above existing ground would be limited to a height sufficient to confine average annual peak flows and could vary from 0.5 to 6.8 feet with an approximate average depth of 3 feet. This would result in an irregular series of relatively low mounds of dredged material, roughly parallel to the channels, which would simulate the formation of natural levees. The Bayou Shaffer closure would be built to a matching elevation.

(2) Effects on Sediment Type. The dredged material would be of similar grain size to the existing bank material, predominantly sand with varying proportions of silt and clay.

(3) Effects on Dredged/Fill Material Movement. Considerable spreading and settling of the material would be expected, however, areas selected for dredging would be those with coarser grain sizes, which would maximize natural angles of repose, thereby minimizing the movement of material and the area needed for disposal. Some sorting and dispersal of fines would result from ambient water circulation and occasional flooding by headwater flows or tropical storms. Some of the unconfined material utilized to fill Bayou Shaffer would slough from the submerged embankment into the bayou unless measures to confine the material were taken.

(4) Physical Effects on Benthos. Riverine habitat in the WLO and LAR is slightly more productive than in the Atchafalaya River above Morgan City because both these water bodies have a high proportion of wide, shallow areas. These shallows would harbor an infauna of chironomids, tubificid worms, Asiatic clams and other groups. Blue crabs and river shrimp would also be present in large numbers. The benthos in the fresh marsh would consist of fauna similar to that in the river, but snails would be more common and organisms would exist in greater numbers. Although cypress-tupelo swamps are generally rich in numbers and diversity of benthos, the swamps immediately adjacent to the river would be likely to have fewer than normal species and numbers because of the constant turbidity and wave action caused by passing vessels. The early successional bottomland hardwoods would have no resident benthic populations, but would harbor a seasonal benthos of chironomids and isopods similar to those present in swamps. Benthic organisms in the 710 acres of riverine habitat, the 160 acres of fresh marsh, the 1420 acres of early successional bottomland hardwoods and the 700 acres of cypress-tupelo swamps would be destroyed by disposal of dredged material. Once the construction was completed, the channel training works would

revegetate with early successional bottomland hardwoods. The perimeters of the mounds would recolonize with a riverine benthos and the upper portions would receive seasonal benthic use.

(5) Actions to Minimize Impacts. The channel training mounds along the LAR and WLO would be placed so as to minimize the amount of marsh destroyed. A dike or cofferdam in the Bayou Shaffer channel would be needed to prevent significant erosion of hydraulic fill material into the water column if soil tests indicated significant erosion potential.

b. Water Circulation, Fluctuation and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. As long as the major bayous exiting from the LAR, such as Chicken Island and Big Wax Bayous, and those leaving the WLO, such as Little Wax Bayou and Bayou Blue, are left open, salinity variations should remain similar to those which exist at present. The amounts of freshwater flowing down the WLO and LAR would prevent salinity intrusion into the fresh marshes.

(b) Water Chemistry. Observed data from a water quality monitoring program conducted in the Atchafalaya Floodway area downstream of Morgan City in 1975 and 1976 indicated little variation in pH of waters: at and near dredging sites and confined disposal areas; and prior to, during, and after dredging. Localized and short-duration increases of alkalinity in the water column would be expected after the introduction of dredged material.

(c) Clarity. Construction activities would significantly reduce water clarity at each work site and downstream because of increased sediment loads. Following construction clarity would improve, however, the greater efficiency of the trained channel would lead to normally higher sediment loads and less clarity.

(d) Color. Water color would be affected similarly to water clarity.

(e) Odor and Taste. No significant effects would be expected.

(f) Dissolved Gas Levels. The dissolved gas of major concern is oxygen. Impacts of dissolved oxygen (DO) levels are discussed in section II.c.(2)(b).

(g) Nutrients. Channel training works below Morgan City would be expected to cause elevation of nutrient levels in the disposal sites. Unless, however, extreme combinations of two or more contributing factors, including low DO, high pH, high temperature, low

water volume in the mixing zone, and high rate of dredged material disposal are present, there should not be any significant long-term adverse water column effects due to elevated nutrient concentrations.

(h) Eutrophication. Eutrophic conditions would not be expected in the LAR or WLO despite temporarily increased nutrient levels, because of the simultaneous increase in turbidity. Marsh areas could, however, experience eutrophication since, at present, they might be nutrient limited.

(2) Current Patterns and Circulation. Channel training works would reduce sheet flow to the adjacent wetlands during periods when flow in the LAR and WLO exceeded the present bankfull stage. The reduction would be most significant below the average annual flood stage. When the outlets were within their banks the channel training works would have no impact on circulation. Reduction of the sheet flow of water and sediment would retard the growth of land and the filling of bayous and ponds adjacent to the outlets. It should be remembered that natural channel and levee development would eventually produce banks similar to channel training works. Channel training would hasten their development. Not only would training works physically reduce overflow of water and sediments, but they would increase the velocity of water, which would also reduce the amount of sediment carried to the adjacent marshes. An additional integral part of channel training below Morgan City is the closure of Bayou Shaffer. Currently, Bayou Shaffer conveys about 12 percent of the flow that passes Morgan City. The closure of Bayou Shaffer would require all of this flow to be conveyed by the Lower Atchafalaya River.

(3) Normal Water Level Fluctuations. This feature would contribute to a lowering of the flowline in the Lower Atchafalaya Basin Floodway. Channel training of the outlets and closure of Bayou Shaffer would reduce the flowline at Morgan City and Wax Lake Outlet by about 1.0 foot. The reduction in flowline would average about 0.5 foot for the EABPL and WABPL. Channel training would also accelerate the time period in which the floodway would become capable of conveying the project flood. This acceleration would be achieved by dredging to build the training works, which in itself would enlarge the channel, and by a reduction in overbank deposition in the early years of the project.

(4) Salinity Gradients. See section II.b.(1)(a) for more detailed discussion. Construction of the channel training works below Morgan City would help to preserve existing salinity gradient patterns more than if no action were taken, which would lead to more rapid freshening of East and West Cote Blanche Bay and slower freshening of the Terrebonne marshes.

(5) Actions That Will Be Taken To Minimize Impacts. Careful control over placement of the material would be exercised to utilize shallow water bottoms adjacent to the channel rather than using existing marsh, whenever possible. In addition, every attempt would be made to avoid filling existing connecting channels which would continue to carry sediment and nutrients to the marshes.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. Suspended particulate and turbidity levels would increase significantly during construction, both at the site and downstream. By reducing river overflow these project features would decrease sediment flow into overbank areas and thereby maintain higher particulate levels in the river. The increased velocities and magnitudes of flow would contribute toward attaining a higher suspended particulate and turbidity level as the norm. After closure, Bayou Shaffer would be less turbid than at present.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be temporarily reduced in the LAR and WLO areas due to increased suspended solids and turbidity levels during dredging and construction of the intermittent mounds in adjacent wetlands. Coarse solids which were resuspended in the water column during dredging and placement of dredged material would settle from suspension in a relatively short period. Furthermore, the brackish salinity of the lower waters might induce coagulation and flocculation of much of the finely divided and colloidal-sized material suspended in the water column during dredging operations. However, the increased velocity and magnitude of flow within the river would be expected to maintain reduced light penetration into the future. Post-construction light penetration in Bayou Shaffer would be greater than at present.

(b) Dissolved-Oxygen. Dissolved-oxygen concentrations in wetland areas are generally dependent upon temperature and flow conditions. During periods of high flow a sufficient supply of fresh-water reaches these areas and dissolved-oxygen concentrations are maintained at a high level. During the low-flow summer months smaller quantities of water reach these areas. Dissolved-oxygen concentrations decline to low levels in the wetland areas because of the increased effect of organic degradation and the lack of a sufficient supply of oxygen from the river or from photosynthetic production. By leaving gaps in the channel training works, natural flow cycles controlling DO in the overbank areas would be preserved as much as possible. Oxygen-demanding sediments within the dredged mounds of material might cause localized DO problems during low flow summer

conditions. However, the predominance of sandy material in the WLO and LAR main channels indicates that the oxygen demand of these sediments should generally be small. The closure of Bayou Shaffer would permanently alter flow conditions in and downstream from that bayou which could significantly reduce DO levels in that area.

(c) Toxic Metals and Organics. Toxic metals and harmful organics are discussed in Section II.d.

(d) Pathogens. No effect as a result of proposed activities.

(e) Esthetics. Higher turbidity levels in the river, Bayou Shaffer, and surrounding wetlands would detract from esthetic appeal. Until the mounds created by dredged material disposal became vegetated, they would also be expected to detract from the area's esthetics.

(3) Effects on Biota.

(a) Primary Production. Primary production is limited in the turbid LAR and WLO. Diatoms and green algae are the most common groups and usually occur in greater numbers when the turbidity drops during the low-water period. Construction of channel training works and the closure of Bayou Shaffer would significantly increase turbidity for the construction periods and thus reduce primary productivity during the period when it was highest. However, this effect would only be felt during the construction period and phytoplankton populations should regain their usual numbers and diversity the next year. The turbidity would also reduce benthic primary productivity in the shallow riverine waters during construction. On completion of the closure of Bayou Shaffer, primary productivity would increase in the entire bayou due to reduction of turbidity.

(b) Suspension/Filter Feeders. Turbidity would interfere with feeding by suspension and filter feeders, but the impact should be temporary and limited to the construction period and the vicinity of the construction site. Mobile benthos would probably vacate the area until conditions returned to normal. Some mortality among sedentary species would be expected, however, recolonization should be fairly rapid.

(c) Other Organisms Affected by Turbidity. No significant effect would be expected on sight feeding organisms; they would vacate the turbid area and return once turbidity became reduced. The river fish community is adapted to high ambient levels of turbidity.

(4) Actions Taken to Minimize Impacts. Construction during low water would minimize the turbidity engendered by the feature.

Confining dikes or cofferdams should be employed at the Bayou Shaffer site unless the fill material proves to be sufficiently stiff to withstand significant erosion by water movements. A silt curtain might be used as a turbidity control device for upper water layers. The culvert through the Bayou Shaffer closure would prevent serious dissolved oxygen deficits downstream.

d. Contaminant Determinations. The Atchafalaya River is not believed to harbor dangerous levels of toxic substances. A sampling program conducted by the New Orleans District, Corps of Engineers in 1975 included five sites (see Plates G-17 and G-18) in the immediate vicinity of the proposed channel training works. Tables G-11-18 through G-11-23 list the measured concentrations of toxic substances and other parameters in water and sediment samples and elutriate mixtures. Also shown are current EPA criteria for chronic exposure of aquatic life to toxic pollutants. Although a limited number of criteria exceedences occurred, no consistent pattern of contaminant releases was shown by the elutriate tests, which indicate conditions that would exist immediately after discharge of hydraulically dredged material into a water body. Some parameters, notably cyanide, cadmium, and chromium, could not be detected at levels comparable to EPA criteria, but are not believed to vary significantly from the other parameters in their tendencies to remain in solution after dredging occurs. These data, together with the temporary and localized effects upon particular segments of the ecosystem, do not suggest any significant adverse impacts.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. As described above, phytoplankton populations in this large, turbid river system are generally low execpt during low water. Zooplankton populations are also somewhat limited. Rotifers and light-bodied cladocerans and copepods dominate the plankton and generally peak during high water periods. The cypress-tupelo swamps adjacent to the LAR have somewhat lower zooplankton numbers and diversity than swamps in the basin proper because of the turbidity caused by vessel traffic. The zooplankton in fresh marsh would be similar to those in the river. When the early successional habitat is flooded it also harbors zooplankton populations similar to those in the river. Construction of channel training works would permanently remove 700 riverine acres, 710 acres of cypress-tupelo, and 160 acres of fresh marsh from the aquatic ecosystem except at highwater. Approximately 1420 acres of early successional bottomland hardwoods that are seasonal aquatic habitat would be part of the aquatic system only during high water. Turbidity impacts to plankton are discussed in Section II.c.(3) above.

(2) Effects on Benthos. The effects of burial on benthos are discussed in section II.a.(4) above and the effects of turbidity are discussed in section II.c.(3)(b) above. The numbers and diversity

TABLE G-11-18

WATER AND SEDIMENT DATA
SITE NO. 1, 1975 (TWO MEASUREMENTS)
GIWW AT WAX LAKE OUTLET (WEST SIDE)

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					21,400/17,600
Residue, Suspen. 110C	68,000/132,000				
Residue, Tot. Nonfil, 105C	42,000/50,000				
Residue, Vol. Susp.	2,000/22,000				
Oil and Grease		0/2,000			1/1
Chlorides					
COD	10,000/21,000		24,000/12,000		9,500/7,400
DKN		660/260			
TKN			2,100/7,300		400/270
Cyanide	0/10		30/0	3.5	0/0
Phenols	13/15		11/6	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.10/0.07
Lead		0/1	2/1	3.8*	10/20
Zinc		0/8	10/1	47	27/28
Chromium		0/0	0/0	0.29	5/6
Cadmium		0/0	0/0	0.025*	1/1
Copper		3/3	5/9	5.6	6/6
Nickel		0/1	1/2	96*	5/10
Arsenic		1/1	2/1	40	0/0
2,4-D	0.03/0.03			370	
2,4,5-T	0.01/0.00				
DDD					0.0016/0.0011
DDE					0.0005/0.0004
DDT					0.0005/0.0005
Dieldrin					0.0003/0.0002
Endrin					0.0/0.0002
Silvex	0.01/0.00				

TABLE G-11-19

WATER AND SEDIMENT DATA
SITE NO. 2, 1975
BAYOU BOEUF AT BAYOU SHAFFER

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					9,930/17,800
Residue, Suspen. 110C	124,000/96,000				
Residue, Tot. Nonfil, 105C	104,000/62,000				
Residue, Vol. Susp.	18,000/8,000				
Oil and Grease	1,000/0.0				1/1
Chlorides					
COD	9,000/9,000		12,000/11,000		2,200/11,000
DKN			340/390		
TKN		300/410			130/260
Cyanide	0.00/10		0/0	3.5	0/0
Phenols	18/7		12/11	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.09/0.10
Lead		0/0	0/1	3.8*	10/10
Zinc		6/10	4/0	47	20/21
Chromium		0/0	0/0	0.29	4/4
Cadmium		0/0	0/0	0.025*	1/1
Copper		2/8	8/2	5.6	3/5
Nickel		2/0	1/0	96*	5/5
Arsenic		3/0	0/1	40	0/0
2,4-D	0.06/0.06			370	
2,4,5-T	0.01/0.01				
DDD					0.0002/0.0
DDE					0.0001/0.0
DDT				0.0010	0.0002/0.0
Dieldrin				0.0019	0.0001/0.0
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-20

WATER AND SEDIMENT DATA
SITE NO. 3, 1975
BAYOU BOEUF (UPSTREAM DURING DREDGING, MEAN)

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					
Residue, Suspen. 110C	44,000				
Residue, Tot. Nonfil, 105C	50,000				
Residue, Vol. Susp.	10,000				
Oil and Grease	200				
Chlorides		35,000			
COD	260,000				
DKN		1,450			
TKN					
Cyanide	0			3.5	
Phenols	2.5			2,600	
Calcium		39,200			
Magnesium		12,800			
Manganese					
Iron		3.3		1,000	
Mercury	0.10	0.07		0.20	
Lead	10.3	5.2		3.8*	
Zinc	25	4.3		47	
Chromium	8.3	0		0.29	
Cadmium	0	0		0.025*	
Copper	5.2	2.5		5.6	
Nickel	3.7	0		96*	
Arsenic	2	1		40	
2,4-D	0.038			370	
2,4,5-T	0.07				
DDD	0				
DDE	0				
DDT	0			0.0010	
Dieldrin	0.003			0.0019	
Endrin	0.005			0.0023	
Silvex					

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-21

WATER AND SEDIMENT DATA
SITE NO. 4, 1975
EAST SIDE LOWER ATCHAFALAYA RIVER, MILE 118

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					7,750/4,730
Residue, Suspen. 110C	140,000/160,000				
Residue, Tot. Nonfil, 105C	110,000/128,000				
Residue, Vol. Susp.	28,000/14,000				
Oil and Grease	1,000/1,000				1/1
Chlorides					
COD	13,000/25,000		11,000/5,000		2,400/1,000
DKN		260/310	310/320		
TKN					100/80
Cyanide	0/0		0/10	3.5	0/0
Phenols	12/7		9/10	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.03/0.04
Lead		3/1	2/1	3.8*	10/10
Zinc		0/6	0/0	47	15/12
Chromium		0/0	0/0	0.29	0/2
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/5	3/3	5.6	2/2
Nickel		2/0	1/0	96*	5/5
Arsenic		1/1	1/0	40	1/0
2,4-D	0.04/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0/0.0
DDE					0.0002/0.0
DDT				0.0010	0.0003/0.0
Dieldrin				0.0019	0.0/0.0
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-22

WATER AND SEDIMENT DATA
SITE NO. 5, 1975
WEST SIDE LOWER ATCHAFALAYA RIVER, MILE 118

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					19,500/33,400
Residue, Suspen. 110C	120,000/192,000				
Residue, Tot. Nonfil, 105C	56,000/200,000				
Residue, Vol. Susp.	32,000/8,000				
Oil and Grease	0/0				1/1
Chlorides					
COD	14,000/8,000		8,000/7,000		9,500/9,800
DKN		350/310	230/210		
TKN					360/540
Cyanide	0/0		0/0	3.5	0/0
Phenols	11/12		7/6	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.05/0.07
Lead		0/1	1/1	3.8*	10/20
Zinc		10/0	10/0	47	32/33
Chromium		0/0	0/0	0.29	8/6
Cadmium		0/0	0/0	0.025*	1/1
Copper		25/4	2/8	5.6	8/12
Nickel		2/1	2/0	96*	10/10
Arsenic		1/0	1/0	40	3/3
2,4-D	0.03/0.06			370	
2,4,5-T	0.01/0.01				
DDD					0.0002/0
DDE					0/0
DDT				0.0010	0/0
Dieldrin				0.0019	0.0001/0
Endrin				0.0023	0/0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-23

WATER AND SEDIMENT DATA
SITE NO. 6, 1975
GIWW AT LOWER ATCHAFALAYA RIVER

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					30,400/53,000
Residue, Suspen. 110C	88,000/48,000				
Residue, Tot. Nonfil, 105C	24,000/244,000				
Residue, Vol. Susp.	12,000/18,000				
Oil and Grease	-/0				1/1
Chlorides					
COD	13,000/11,000		26,000/15,000		20,000/37,000
DKN		210/320	3,400/3,700		
TKN					700/1,300
Cyanide	0/0		10/0	3.5	0/0
Phenols	10/11		12/6	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.11/0.11
Lead		1/0	0/1	3.8*	10/20
Zinc		10/10	0/6	47	48/57
Chromium		0/0	0/0	0.29	10/11
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/7	2/9	5.6	12/20
Nickel		2/1	1/0	96*	10/15
Arsenic		0/0	1/1	40	4/3
2,4-D	0.04/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0021/0.0018
DDE					0.0007/0.0
DDT				0.0010	0.0/0.0
Dieldrin				0.0019	0.0001/0.0
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

of benthic organisms in Bayou Shaffer below the closure would increase as the current decreased. The culvert should allow enough flow to prevent dissolved-oxygen problems.

(3) Effects on Nekton. The riverine waters of the WLO and LAR support fairly extensive fish populations. The most common species are catfish, shad, and mullet. These waters, being adjacent to Atchafalaya Bay, are a major thruway for many estuarine species, such as anchovies and menhaden, that utilize marshes and ponds as a nursery area. The wide, shallow portions of the WLO and LAR also furnish nursery space to young fish. The covering of 710 acres of river bottoms would have an impact by removing these acres from aquatic productivity. The perimeters of the channel training mounds would furnish some shallow water areas. The cypress-tupelo swamps adjacent to the LAR would harbor typical swamp fish such as bowfin, crappie and gar. The removal of 700 acres of these swamps from the aquatic ecosystem would have a minor adverse effect on aquatic productivity, because it would remove habitat and also the detritus and nutrients swamps produce. The fresh marshes along the LAR provide nursery and feeding habitat for numerous species of fish such as sheepshead minnows, bluegills, and anchovies. Filling of 160 acres of fresh marsh would destroy its feeding/spawning/nursery potential. The 1420 acres of early successional bottomland hardwoods that would be covered by channel training works are only seasonally flooded at the present. All channel training mounds would revegetate within a few years with young willows on top and marsh plants along the perimeter. This revegetation would return some of the area to the aquatic system, but the overall impact of this feature would be a slight reduction in aquatic productivity.

(4) Effects on the Aquatic Food Web. The filling of 160 acres of marsh, 710 acres of swamp, and 1420 acres of successional hardwoods would reduce their detrital input to the aquatic system. The training works would revegetate with early successional bottomland hardwoods, but these would be flooded less often than they are at present. Loss of this detritus should not be a significant adverse impact. Productivity in Bayou Shaffer would increase slightly after its closure because planktonic and benthic populations would multiply.

(5) Effects on Special Aquatic Sites.

(a) Sanctuaries and Refuges. Channel training works would markedly increase turbidity in upper portions of the Atchafalaya Delta Wildlife Management Area during construction and could produce slightly higher levels after construction.

(b) Wetlands. For purposes of this evaluation, all wooded habitats found in the proposed disposal areas (cypress-tupelo and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would destroy existing vegetation, and plant succession would begin within a year. The disposal areas

would become early successional bottomland hardwoods prior to 2030. Wetland values of the disposal areas would be reduced due to loss of cypress-tupelo habitat and the reduced flooding effected by the channel training works. The overall effects, considering the vast acreages of wetland and aquatic habitat in the basin, would be minor.

(c) Mudflats. At the present time, during low water and/or low tide, mudflats exist along the lower curves of the LAR. Channel training works would fill these flats and they would no longer serve as habitats for benthos or feeding areas for birds. The loss of these areas should not be significant because extensive mudflats are found a few miles south in Atchafalaya Bay.

(6) Wildlife Effects. Channel training works would replace 700 acres of cypress-tupelo with early successional bottomland hardwoods which would have less wildlife value, especially to wading birds. The loss of mudflats would also have a slight adverse impact on wading and shore birds. The channel training works would be placed in the vicinity of two wading bird rookeries near the confluence of Bayou Shaffer and the LAR. Since construction would be at low water, impacts on the nesting success should be minimal. Efforts would be made to avoid actual destruction of rookery sites by careful placement of channel training works. During construction, young and slow-moving animals in disposal areas would be destroyed, and others would be forced to move to adjacent areas where they would face increased intra- and inter-specific competition and might not survive.

(7) Effects on Endangered and Threatened Species. This feature would not cause any significant adverse impact on any endangered or threatened species nor on their critical habitat.

(8) Actions to Minimize Impacts. Careful placement of the channel training works should avoid significant adverse impact to rookeries, reduce the amount of marsh lost and avoid closing existing distributary channels.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determinations. In view of the limited possibility of contamination, mixing zone calculations would not be necessary. Unknown or variable factors such as rates of discharge, quantities of dredged material, and indefinite chemical analyses would at any rate, make such a calculation unduly speculative. Qualitatively, it would be expected that turbidity levels would rise in the river and wetland areas; and DO levels might be reduced in wetland areas.

(2) Determination of Compliance with Applicable Water Quality Standards. Water quality standards are established at the state level (see Tables G-11-6 and G-11-6A). Louisiana standards

include a limited number of parameters which in general do not reflect industrial pollution (chloride, sulfate, DO, pH, coliform bacteria, temperature, and total dissolved solids). With the possible exception of DO and turbidity none of these standards would be violated.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects would be expected.

(b) Recreational and Commercial Fisheries. The covering of nearly 3,000 acres of riverine and wetland habitat would slightly decrease the numbers of recreational and commercial fish in the area. However, this should not significantly impact local fisheries.

(c) Water-Related Recreation. Channel training would close some existing channels, which would have a minor adverse impact on recreational boating. Closure of Bayou Shaffer would necessitate a one-mile longer trip for recreationists going from Morgan City to points south.

(d) Esthetics. The turbidity created by this feature would be unsightly during construction and the mounds and closure dam would not be esthetically pleasing until they revegetated.

(e) Effects on Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Channel training of the Atchafalaya River outlets would not directly impact the Atchafalaya Delta Wildlife Management Area but would increase flows through it, and construction would temporarily increase turbidity. There might be unknown archeological sites within this area. Specifications covering the work to be performed in constructing and maintaining the project features would provide for the preservation of any items of apparent historical or archeological interest.

(f) Determination of Cumulative Effects on the Aquatic Ecosystem. The channel training works below Morgan City are part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control objectives, which are of great importance in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall, then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment, especially through environmental easements. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The total direct construction impacts of this entire project would result in the loss or modification of approximately 6,000 acres of cypress-tupelo, 9,000 acres of mid-to-

late successional bottomland, and 6,000 acres of early successional bottomland hardwoods. This compares to approximately 451,000; 332,000; and 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-110, Volume 1). On a percentage basis, construction of the entire project would cause a respective loss of 1.3, 2.7, and 6.0 percent, of these habitat types. The terrestrial habitat loss caused by the feature considered in this 404(b)(1) Evaluation would be an even smaller percentage of the total loss. Channel enlargement in the WLO and LAR would reduce the diversity of subaqueous conditions in those waterways. The channels would have more uniform bank habitat, flow patterns, temperature gradients, and flood stages. Shifting bed loads, areas of scouring and deposition, and increased particulate loads would be expected to continue to exist. These occurrences would inhibit normal aquatic growth. The delta area at the river mouth would aggrade slightly more rapidly than present with fine sand and silt layers. Increased channel capacity would reduce overflow and use of the floodplain as a source of organic nutrients and detritus. Thus, disposal of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat in Louisiana, but this amount of loss and/or conversion of habitats is acceptable in the overall public interest.

(g) Determination of Secondary Impacts. All existing trees on the disposal areas would be killed (see Table G-11-17 for habitat types). The areas would revegetate as early successional bottomland hardwoods with a small amount of marsh occurring on the perimeter of the mounds. The major secondary impact would be reduction of overbank flows which would decrease the amount of nutrients and sediment being supplied to adjacent wetlands, mainly fresh marshes. By leaving most existing distributary channels open, existing channel flows to adjacent areas would be maintained. Quantification of the impact of reducing overbank flows is difficult. The area between the LAR and Bayou Shaffer has been losing wetlands and gaining scrub/shrub and open water in the period between 1956 and 1978. This trend would be expected to continue and slightly accelerate due to channel training. The marshes between the WLO and LAR and adjacent to each waterway are presently losing acreage at a lower rate than marshes farther away from these waterways. This lower loss rate is due to the sediment nourishment they receive. Channel training works, by reducing overflow, would reduce the amounts of sediment these marshes receive, but it is not possible to quantify this impact. The Atchafalaya Bay modeling effort currently being conducted by WES is expected to develop a tool to determine how the proposed channel training works would affect future delta building, salinities, and overbank sedimentation.

III. FINDINGS OF COMPLIANCE FOR CHANNEL TRAINING BELOW MORGAN CITY.

a. No significant adaptations of the guidelines were necessary for this evaluation.

b. Channel training below Morgan City has no alternative except no-action. The no-action plan would be most environmentally desirable, but channel training was chosen because it would produce a lowered flowline, and therefore levee raising would be less costly.

c. The Atchafalaya River, along its entire length, has been designated by the State of Louisiana for primary and secondary contact recreation and propagation of fish and wildlife, and for domestic water supply above Bayou Boeuf. The river water is characteristically highly turbid, and also is high in suspended solids, dissolved oxygen, nitrogen, and phosphorus. Waters leaving the floodway through the Lower Atchafalaya River and Wax Lake Outlet provide continuing nourishment to the estuarine and marine areas of the lower basin. Atchafalaya Basin waters are relatively free of toxic substances, including heavy metals and pesticides. Each of the channel training works and the Bayou Shaffer closure would likely cause a noticeable rise in turbidity levels in the area. Since no numerical standards exist for turbidity or suspended sediment, a mixing zone could not be defined for these parameters. On a qualitative basis no violations would be expected. There is no evidence from available data that any other regulated parameter would occupy a large enough portion of the water column to inhibit movements of free-swimming and drifting organisms. On the basis of available data, there would be no significant violations of applicable State of Louisiana water quality standards associated with implementation of this project feature.

d. No violations of the Toxic Effluent Standards of Section 307 of the Clean Water Act would be expected.

e. The proposed discharge would not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or adverse modification of any critical habitat.

f. No designated marine sanctuaries are in the project area.

g. The proposed disposal of dredged material would not result in significant adverse effects on aspects of human health and welfare such as: municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, and the above-mentioned special aquatic sites. There would be no significant adverse effects on life stages of aquatic animals or other wildlife dependant on aquatic ecosystems. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability would not occur. Recreational, aesthetic, and economic values would not be adversely impacted in a significant manner.

h. Appropriate and practical steps taken to minimize potential adverse impacts of the discharge of material into aquatic ecosystems include using only those areas of wetlands necessary for project completion and leaving all possible existing channels open. Placement

of material in shallow water areas should be performed during low water period to minimize erosion. If engineering tests of hydraulic clay fill material for the Bayou Shaffer closure indicate significant erosion potential, dikes or cofferdams should be provided to prevent direct contact of the dredged material with flowing water.

i. On the basis of the guidelines the proposed disposal sites for the discharge of fill material are generally specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

Maintenance Dredging

I. PROJECT DESCRIPTION.

a. Location. The proposed maintenance dredging would occur at a number of sites within the Atchafalaya Basin Floodway System in south central Louisiana.

b. General Description. The Atchafalaya River is formed near Simmesport, Louisiana, where Old River and Red River meet. The river then flows about 140 miles to Atchafalaya Bay, an arm of the Gulf of Mexico. The Atchafalaya River is the major distirbutary of the Mississippi River, and the basin through which it flows serves as a major floodway during times of high flow. The Atchafalaya Basin Floodway System consists of three separate floodways, the West Atchafalaya and Morganza Floodways to the north, and the Lower Atchafalaya Basin Floodway to the south. The Lower Atchafalaya Basin Floodway begins about the latitude of Krotz Springs and extends southward to the vicinity of Morgan City. Below the latitude of Morgan City, two outlets, the Wax Lake Outlet and the Lower Atchafalaya River, pass water through to Atchafalaya Bay and eventually to the Gulf of Mexico. More detailed descriptions of the project area are in the Main Report and Environmental Impact Statement (EIS) and in the Technical Appendices. Plate G-1 is a General Map of the area.

c. Authority and Purpose. The proposed dredging is authorized by the Flood Control Act of 15 May 1928, Public Law 391-70, as amended, and as modified by subsequent authorizations. The proposed work consists of dredging at the following locations: Old River Lock Tailbay, Three Rivers (mile 0 Atchafalaya River), McCrea Landing (mile 12 Atchafalaya River). Below Bayou Sorrel (alternate Route GIWW), East Freshwater Distribution Channel, East and West Access Channels, Grand and Sixmile Lakes, and Berwick Bay Harbor and Berwick Lock Forebay. The overall purpose of this maintenance dredging is to maintain authorized depths for navigation. Brief descriptions of the individual projects follow:

(1) Old River Lock Tailbay. Old River Lock is located in a land cut approximately 1.5 miles long which provides for navigation between the Mississippi River and the Red and Atchafalaya River systems. The navigation channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(2) Three Rivers (mile 0 Atchafalaya River). Three Rivers maintenance dredging would be in Old River at the juncture of Old, Atchafalaya, and Red Rivers, and would extend along the Old River channel about 3,000 feet. The navigation channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(3) McCrea Landing. McCrea Landing is a bar crossing about 3,500 feet long in the Atchafalaya River at mile 12. The navigation channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(4) East Freshwater Distribution Channel. The site of this work would be located within the Atchafalaya Basin Floodway in Iberville and St. Martin Parishes. The 9-mile channel follows the course of the Upper Grand River westward from the East Atchafalaya Basin Protection Levee to the intersection with Little Tensas Bayou; thence southerly down this bayou to its juncture with the Blind Tensas Cut--Lake Mongoulois segment of the Atchafalaya Basin main channel. The channel would be maintained to a depth of minus 9 feet NGVD and 80 feet wide (to provide a cross sectional area of 1,000 square feet below low water).

(5) East and West Access Channels. The East and West Access Channels connect laterally to the main channel of the Atchafalaya River in the vicinity of river Mile 78 (1963 mileage). The 12-mile-long East Access Channel begins in the East Atchafalaya Basin Protection Levee borrow canal at the south end of Bayou Sorrel lock and proceeds northerly to the intersection of Bayou Sorrel. A one-mile-long bypass channel was dredged to avoid the first oxbow in Bayou Sorrel. The channel then follows the alinement of Bayou Sorrel westerly for about 6 miles, where it departs Bayou Sorrel and enters a straight dredged channel approximately 2.5 miles long, terminating in the Big Bayou Chene segment of the Atchafalaya River main channel. The West Access Channel begins about one mile north of the terminus of the East Access Channel in Big Bayou Chene. The West Access Channel follows generally the alinement of Bayou Chene westerly into Bayou Crook Chene, through Alligator Bayou, into Little Gonsoulin Bayou and intersects Lake Fausse Pointe Cut. (There are several sections in this segment which have been dredged outside of the natural watercourse to improve channel alinement.) The West Access Channel continues down Lake Fausse Pointe Cut about one mile, then proceeds to its end at Dauterieve Landing on Grand Bayou. East and West Access Channels would be maintained to a depth of minus 7 feet NGVD and 80 feet wide, and provide for navigational access across the Atchafalaya Basin to waterways in the vicinity of the East and West Atchafalaya Basin protection levees.

(6) Below Bayou Sorrel (Alternate Route GIWW). Shoaling in the first mile or two of the alternate GIWW below Bayou Sorrel lock occurs as stages of the Atchafalaya River fall. Maintenance dredging would be required to maintain adequate depths for navigation. The channel is authorized to be maintained at 12 feet deep and 125 feet wide.

(7) Grand and Sixmile Lakes. Proposed maintenance of the navigation channel through Grand and Sixmile Lakes would consist of

dredging to minus 12 feet NGVD and 125 feet wide from about Mile 105 to Mile 114. Normal maintenance dredging procedures involve dredging up to four feet below the authorized depth as a practical achievement of "advance maintenance."

(8) Berwick Bay Harbor and Berwick Lock Forebay. Dredging in Berwick Bay Harbor would consist of removal of shoal material riverward of a line approximately 25 feet collectively from the face of the docks to the minus 12-foot NGVD contour in the river on both the Berwick and Morgan City sides of the harbor. Dredging might be required on the Berwick side from about Mile 116.3 to Mile 118.9 (1963 mileage below the intersection of Red, Old, and Upper Atchafalaya Rivers on the Atchafalaya River). Dredging on the Morgan City side of the harbor might be required from about Mile 116 and extend along the harbor front into Bayou Boeuf (GIWW) and to the levee closure at the west end of Bayou Boeuf Lock. Approximately 1,800 feet of dredging might be required from the Lower Atchafalaya River across a tidal flat through the forebay of Berwick Lock (Mile 116.2 AR). Additional periodic dredging is required in the vicinity of Berwick Lock.

d. General Description of Dredged or Fill Material. The material to be dredged would consist of silts, clay, and fine-to-coarse-grained sand, and includes stumps, roots, and logs. Material dredged from the main channel of the Atchafalaya River would be predominantly sand (0.074 mm or greater). Off-channel ares, such as the distributary channels and GIWW Alternate Route, would contain greater percentages of silts and clays (less than 0.074 mm in diameter). About 2,170,000 cubic yards of material would be dredged annually.

e. Description of Proposed Discharge Sites.

(1) Location. Plate G-20 shows the general location of maintenance dredging sites. Plates G-21 through G-27 indicate specific locations where disposal would be placed. Table G-11-24 shows frequency of dredging at each site, the average annual dredging requirements, the general locations of disposal areas, and acreage and habitat types to be affected by discharge of dredged material.

(2) Size. Approximately 5,800 acres would be required for disposal of dredged material over the life of the project. The confined disposal sites are already in existence. Some have been utilized and others have never been disposed in.

(3) Types of Sites. The within-water disposal associated with dredging at Three Rivers, McCrea Landing, Grand and Sixmile Lakes, and Berwick Harbor and Lock would be unconfined. All other disposal sites would be diked with the clarified effluent returned to the nearest deepwater channel through flow control structures.

TABLE G-11-24

MAINTENANCE DREDGING

Location	Dredging Frequency	Average Annual Yardage (C.Y.)	Location of Spoil Disposl Areas	Acreage and Habitat Type of Disposal Areas
Old River Lock Tailbay	Once every 10 years	7,000	Confined on north bank of channel	160 BLHW
Three Rivers (Mile 0 Atchafalaya River)	Annually	150,000	In deep water in Atchafalaya River	
McCrea Landing (Mile 12 Atchafalaya River)	Once every 15 years	23,000	Disposed in shallow water in Atchafalaya River along either side of dredged channel	
East Freshwater Distribution Channel	Once every 10 years	160,000	Confined on bank adjacent to waterway	300 CT 670 BLHW
East and West Access Channels	Once every 10 years	610,000	Confined on bank adjacent to waterway	470 ES 1700 BLHW
Below Bayou Sorrel (Alternate Route GIWW)	Annually	170,000	Confined on bank adjacent to waterway	400 CT
Sixmile Lake	Once every 5 years	480,000	Disposed in deep water in Atchafalaya River and contained sites on north bank	2500 ES
Berwick Bay Harbor	Annually	500,000	Disposed in deep water in Atchafalaya River	
Berwick Lock Forebay	Once every 2 years	70,000	In deep water on Atchafalaya River and adjacent to river bank below the forebay	60 ES

ES = Early successional bottomland hardwood
BLHW = Mid to late successional bottomland hardwood
CT = Cypress-tupelo

(4) Types of Habitat. Discharge would occur in four habitat types, early successional bottomland hardwoods, mid to late successional bottomland hardwoods, cypress-typelo, and open water. For purposes of this evaluation, all disposal sites indicated are considered to be wetlands or waters of the US. Acreages required include 2,970 acres of early successional bottomland hardwoods, 2,530 acres of mid to late successional bottomland hardwoods, and 300 acres of cypress-tupelo.

(5) Timing and Duration of Discharge. Dredging would generally take place during low flow periods (summer and fall) and might extend from a few days to several weeks or more, depending on the site and the quantity of material to be dredged. As shown in Table G-11-24, dredging at a site might occur annually or as infrequently as once every 10-15 years.

f. Description of Disposal Method. Hydraulic dredging would be used in all instances.

II. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Material placed in deep water channels would be displaced downstream as suspended sediment or bedload and would not significantly affect substrate elevation or slope. In the wetland sites, existing elevations range from about 0-2 feet NGVD to 10-40 feet NGVD. Disposal over time would raise elevations. Land-disposed materials would be well distributed to promote drainage and consolidation.

(2) Sediment Type. The dredged material would generally be similar to that in the disposal areas, with the exception that it would contain less organic material in the case of disposal in wetland habitats. Both the dredging and disposal sites would contain material of alluvial origin.

(3) Dredged/Fill Material Movement. Material placed in open water would move downstream as suspended sediment or bed load. All other material would be placed in confined disposal sites. Leaching during storm events would be expected, but dikes and weirs would be sufficiently high to prevent overflow during storms.

(4) Physical Effects on Benthos. Disposal of dredged material into relatively deep water habitats would destroy those organisms present, but these areas generally do not support diverse or abundant populations of benthos. Also, recolonization would occur rather rapidly. Of the other disposal sites, only the cypress-tupelo habitat supports resident populations of benthos. These would be destroyed by disposal. Seasonal use of the early and mid to late successional bottomland hardwood habitats would be reduced by disposal.

(5) Other Effects. Existing vegetation (300 acres cypress-tupelo, 2,530 acres mid-to-late successional bottomland hardwoods, and 2,970 acres of early successional bottomland hardwoods) in the disposal sites would be destroyed over the project life, but the areas would revegetate over time to early successional bottomland hardwoods. Kinds and numbers of animals using the disposal sites would be dependent on the successional stage of the vegetation in the areas.

(6) Actions Taken to Minimize Impacts. To the extent feasible, disposal sites have been located to avoid adverse impacts to high quality habitat. The discharge would be confined to the smallest practicable area commensurate with adequate drainage capability, and the effluent returned to channel areas to avoid unnecessary adverse impacts on adjacent wetlands or shallow water bottoms.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water.

(a) Salinity. No effect.

(b) Water Chemistry. Observed data from a water quality monitoring program conducted in the Atchafalaya Floodway area downstream of Morgan City in 1975 and 1976 indicated little variation in the pH during testing. Tests were conducted at and near dredging sites and confined disposal areas, and prior to, during, and after dredging.

(c) Clarity and Color. Dredged material disposal in waterways would reduce clarity and produce visible plumes downstream from the sites. Clarity and color would return to normal soon after dredging was completed.

(d) Odor and Taste. Significant effects on water odor and taste are not expected.

(e) Dissolved Gases. During the dredging operation, dissolved-oxygen in the immediate area downstream of the open-water disposal area might fall below ambient concentrations due to oxygen demanding substances in the dredged material. However, due to the short-term nature of the work, the normally high ambient dissolved oxygen concentration, and natural turbulence of the river, this effect is expected to be of short duration and very localized. Some localized reductions in dissolved oxygen within confined disposal areas and in vicinity of effluent return would be expected.

(f) Nutrients. Macronutrients are normally high in the Atchafalaya River system. Significant effects of increasing the amount of available nutrients are not expected in the river, however,

disposal areas would experience elevated levels. Elutriate tests of representative dredged materials have shown ammonia-nitrogen to be present above ambient levels. In un-ionized form, ammonia is toxic to aquatic organisms. However, in a river system such as the Atchafalaya which exhibits a nearly neutral pH, is highly buffered, and has a large dilution capacity, toxic ammonia problems are not expected to develop.

(g) Eutrophication. Acceleration of eutrophication is not expected as a result of open water disposal, however, in confined disposal areas localized eutrophication might occur.

(2) Current Patterns and Circulation. Maintenance dredging would be expected to have little effect on the river currents or circulation other than to promote more uniform conditions. Current patterns and circulation in the wetland areas designated for disposal would be eliminated. Wetland areas adjacent and landward of disposal areas would receive reduced flow.

(3) Normal Water Level Fluctuations. Maintenance dredging, by sustaining a relatively unchanging channel, would slightly moderate normal water fluctuations. Moderation would not alter average discharges, but would reduce the extremity of high and low water levels. In wetlands not altered by disposal, water levels would be moderated and be expected to decrease, however, reduced sediment and organic input due to less circulation could tend to keep water levels approximately the same.

(4) Salinity Gradients. No significant effects.

(5) Actions that will be Taken to Minimize Impacts. Dredged material would be placed into confined disposal sites. As solid materials settle, transport water would be returned to adjacent water channels through controlled spillgates constructed in the retention dikes. The effluent from these areas should not pose any significant water quality problems if retention times are sufficient. In areas located along the main channel, such as Three Rivers, McCrea Landing, and Berwick Harbor, open water disposal is considered the least environmentally damaging alternative. Open water discharge would have only minor and short-term effects, whereas land disposal would destroy valuable wildlife habitat.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. The lower Atchafalaya River is turbid and has a high concentration of suspended sediments. The dredged material is predominately sand with some silt, and would be placed mostly in confined areas to keep lateral movement and filling of aquatic and terrestrial habitat to a minimum. The effluent from

the confined disposal areas would be returned to the river and should not significantly increase suspended particulates or turbidity above ambient levels except in the immediate discharge area. At the dredging sites and in the open water disposal sites elevated suspended particulate and turbidity levels would occur. A turbidity plume would be visible downstream of the open water disposal sites.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Light penetration would be reduced in the vicinity of the dredging operations and open water disposal sites. These effects would be localized and temporary.

(b) Dissolved Oxygen. Dissolved oxygen in aquatic habitats within the confined disposal sites and in the vicinity of the dredging operations and open water disposal would be reduced. Again, these effects would be localized and temporary.

(c) Toxic Metals and Organics. Table G-11-5, 16, 21, 22, and 25 through 28 show water and sediment data collected near maintenance dredging sites. Some of the laboratory analyses of water constituents were conducted at detection limits that exceeded EPA criteria, and thus are inconclusive. Data collected by EPA indicated few toxic metal problems in the Atchafalaya Basin. Elutriate tests indicated toxic levels due to dredging would be equal to or less than the concentrations found in native water. Also, since these same bottom materials are resuspended and relocated by river currents, particularly during flood periods, significant adverse effects caused by maintenance dredging in the Atchafalaya Basin Floodway System would not be expected.

(d) Pathogens. No significant effects.

(e) Esthetics. The increased turbidity caused by dredging and open water disposal would be localized and temporary. The esthetic appeal of confined disposal sites would be minimal until revegetation occurs. Fifty-eight hundred acres of wetlands would be altered by use as disposal sites.

(3) Effects on Biota.

(a) Primary Production, Photosynthesis. Primary production in large, turbid, alluvial rivers like the Atchafalaya is low, with most of the food energy coming from outside the river in the form of organic detritus. Covering about 5,800 acres of cypress-tupelo and bottomland hardwoods with dredged material over the project life would temporarily remove a significant source of organic detritus from the lower Atchafalaya ecosystem, but revegetation with early successional bottomland hardwoods would occur rapidly. The phytoplankton production in the cypress-tupelo habitats would be lost, and use of the

TABLE G-11-25

WATER AND SEDIMENT DATA
SITE NO. 7, 1975
SIXMILE LAKE

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					5,250/12,800
Residue, Suspen. 110C	144,000/284,000				
Residue, Tot. Nonfil, 105C	44,000/278,000				
Residue, Vol. Susp.	20,000/22,000				
Oil and Grease	2,000/0				1/1
Chlorides					
COD	14,000/11,000		14,000/9,000		1,900/4,600
DKN		310/250	260/410		
TKN					84/300
Cyanide	0/0		0/0	3.5	0/0
Phenols	12/17		10/8	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.05/0.08
Lead		1/1	0/1	3.8*	10/10
Zinc		10/0	0/0	47	17/25
Chromium		0/0	0/0	0.29	3/4
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/4	2/3	5.6	2/3
Nickel		2/1	2/0	96*	5/10
Arsenic		2/0	2/1	40	0/0
2,4-D	0.02/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0008/0.0004
DDE					0.0002/0.0001
DDT				0.0010	0.0/0.0
Dieldrin				0.0019	0.0004/0.0001
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-26

WATER AND SEDIMENT DATA
SITE NO. 8, 1975
BERWICK LOCK ENTRANCE CHANNEL

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					23,400/18,000
Residue, Suspen. 110C	108,000/192,000				
Residue, Tot. Nonfil, 105C	28,000/82,000				
Residue, Vol. Susp.	20,000/18,000				
Oil and Grease	2,000/1,000				1/1
Chlorides					
COD	11,000/12,000		11,000/11,000		9,500/5,400
DKN		300/410	460/400		
TKN					330/230
Cyanide	0/0		10/0	3.5	0/0
Phenols	18/21		12/7	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.1	0.20	0.08/0.13
Lead		1/2	1/1	3.8*	10/10
Zinc		4/0	0/0	47	4/26
Chromium		0/0	0/0	0.29	4/5
Cadmium		0/0	0/0	0.025*	1/1
Copper		4/3	3/3	5.6	7/6
Nickel		2/2	2/1	96*	5/10
Arsenic		2/1	0/1	40	4/0
2,4-D	0.03/0.04			370	
2,4,5-T	0.01/0.01				
DDD					0.0013/0.0
DDE					0.0008/0.0
DDT				0.0010	0.0012/0.0
Dieldrin				0.0019	0.0003/0.0
Endrin				0.0023	0.0002/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-27

WATER AND SEDIMENT DATA
SITE NO. 9, 1975
BERWICK BAY FLOODWALL

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Residue Lost on Ignit.					5,630/5,430
Residue, Suspen. 110C	120,000/132,000				
Residue, Tot. Nonfil, 105C	40,000/36,000				
Residue, Vol. Susp.	8,000/18,000				
Oil and Grease	2,000/3,000				1/1
Chlorides					
COD	12,000/11,000		11,000/15,000		1,200/1,600
DKN		290/260	300/260		
TKN					100/130
Cyanide	0/0		0/0	3.5	0/0
Phenols	12/8		9/8	2,600	
Calcium					
Magnesium					
Manganese					
Iron				1,000	
Mercury		0.0/0.0	0.0/0.0	0.20	0.05/0.05
Lead		1/0	0/0	3.8*	10/10
Zinc		10/6	0/0	47	16/17
Chromium		0/0	0/0	0.29	4/3
Cadmium		0/0	0/0	0.025*	1/1
Copper		2/4	3/2	5.6	2/1
Nickel		2/2	2/2	96*	5/5
Arsenic		1/1	1/2	40	0/0
2,4-D	0.06/0.06			370	
2,4,5-T	0.01/0.01				
DDD					0.0002/0.0003
DDE					0.0/0.0
DDT				0.0010	0.0002/0.0
Dieldrin				0.0019	0.0003/0.0001
Endrin				0.0023	0.0/0.0
Silvex	0.01/0.01				

*Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.

TABLE G-11-28

WATER AND SEDIMENT DATA
SITE NO. 11B, 1981 SAMPLING
FLOODSIDE BORROW PIT IN TOWN OF BAYOU PIGEON

Parameter	Water Sample Total ug/l	Water Sample Dissolved ug/l	Elutriate ug/l	EPA Aquatic Life Criteria ug/l	Sediment mg/kg
Total Solids, % by Wgt					50.1
Total Volatile Solids					1.65
Turbidity	30,000				
Suspended Solids	51,800				
Volatile Suspended Solids	21,600				
Oil and Grease					174
Chlorides	30,000				
COD	11,000	11,000	23,000		75,500
TKN	870		860		792
Cyanide	< 10		< 10	3.5	
Phenols	< 10		< 10	2,600	
Nitrite-N	31		67		< 0.20
Nitrate-N	1,430		1,360		< 0.20
Total Nitrogen-N	2,330		2,290		792
Ammonia-N	50		235	20**	17.0
OrthoPhosphate-P	69	23	< 10		1.96
Total Phosphorus-P	170	< 100	< 100		656
Calcium	40,300	39,600	36,700		
Magnesium	11,500	11,400	12,500		
Manganese	101	23	519		440
Iron	2,130	46	< 25	1,000	33,000
Mercury	< 0.2	< 0.2	< 0.2	0.20	< 0.10
Lead	3	< 1	< 1	3.8*	19.3
Zinc	< 25	< 25	< 25	47	95.9
Chromium	2	< 1	< 1	0.29	32.7
Cadmium	0.4	0.2	0.1	0.025*	0.27
Copper	5	3	5	5.6	27.8
Nickel	< 1	< 1	< 1	96*	38.7
Arsenic	1	< 1	1	40	6.72

* Criterion is hardness-dependent; $CaCO_3$ concentration of 100 mg/l assumed.
**Criterion is for un-ionized ammonia, which would comprise about 1 percent of total ammonia at anticipated pH and temperature conditions.

disposal areas by planktonic organisms during high water would be reduced. Significant effects on photosynthesis would not occur.

(b) Suspension/Filter Feeders. Riverine and distributary habitats in the Atchafalaya Basin generally support sparse benthic populations compared to other aquatic habitats. For example, the mean number of benthic organisms per square meter in riverine areas was found to be 327, as compared to 1,840 in headwater lakes, 3,292 in bayous, and 3,768 in swamps. Tubificid worms, chironomids, burrowing mayflies, damselfly nymphs, and Asiatic clams are commonly found in riverine habitats. Initially, these organisms would be lost at the dredging sites, but recolonization would occur. In disposal sites, the loss of cypress-tupelo habitat (which supports the largest number of benthic organisms) would result in the reduction of populations of amphipods, clams, dipteran larvae, snails, isopods, and mayflies. These areas would be flooded only during high-flow events.

(c) Sight Feeders. No appreciable effects on sight feeders would be expected in the vicinity of dredging operations. About 300 acres of cypress-tupelo swamps, which support sight feeders such as largemouth bass, bowfin, shad, warmouth, and crappie, would be lost. Use of other terrestrial habitats in the disposal areas by sight feeders during moderate to low flows would be reduced.

(4) Actions Taken to Minimize Impacts. See sections II.a.(6) and II.b.(5).

d. Contaminant Determinations. The material proposed for discharge are similar to that in the disposal sites, and contaminant levels would be expected to be low. The proposed discharge would not be expected to introduce, relocate, or significantly increase contaminants.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Plankton populations in the Atchafalaya River and distributaries consist mainly of diatoms, desmids, cladocerans and copepods. No significant effects would occur in the main channel. Plankton populations in disposal areas, primarily confined to the cypress-tupelo habitats, would be lost.

(2) Effects on Benthos. See Section II.c.(3)(b).

(3) Effects on Nekton. No significant effects in main channel. Fish populations in cypress-tupelo habitat in disposal reas would be lost and use of other habitats in disposal areas by fishes would be reduced.

(4) Effects on Aquatic Food Web. Loss of about 5,800 acres of vegetated aquatic and terrestrial habitat over the project life would reduce detrital material available for processing and use in the aquatic food web.

(5) Special Aquatic Site Effects-Wetlands. As noted earlier, for purposes of this evaluation, all habitats found in the proposed disposal areas (cypress-tupelo, mid to late successional bottomland hardwoods, and early successional bottomland hardwoods) are considered wetlands. The proposed discharge would destroy existing vegetation and plant succession would begin within a year. If not modified by subsequent dredging and disposal, these areas (or portions of them) would succeed into early successional bottomland hardwood. Future disposal would reinitiate the process. Wetland values of the disposal sites would be reduced due to less frequent flooding.

(6) Threatened and Endangered Species. No significant effects. See Appendix H and EIS for detailed discussion.

(7) Other Wildlife. The proposed discharge would result in the loss of about 5,800 acres of wildlife habitat over the project life, including 300 acres of cypress-tupelo, 2,530 acres of mid to late successional bottomland hardwoods and 2,970 acres of early successional bottomland hardwoods. The mid to late successional bottomland hardwoods provide the best wildlife habitat in the basin, with an abundance of soft and hard mast producing trees, a diverse woody understory, and abundant herbaceous groundcover. This is the best habitat type in the basin for white-tailed deer, squirrels, non-game mammals, and some furbearers. Bird species diversity and numbers per unit area are highest in this habitat. Early successional bottomland hardwoods of the type found in the proposed discharge sites (primarily young, dense stands of willow) do not represent a quality habitat for most species of wildlife, but are heavily used by certain seasonally abundant species such as the yellow-rumped warbler or by white-tailed deer when basin water levels are low. The lack of mast and browse probably accounts for the low carrying capacity and species diversity. The cypress-tupelo swamp habitats are primarily favorable for wildlife species that are water-oriented at some stage of their life cycle. They are less productive overall than the more mature bottomland hardwoods, but more productive than the early successional bottomland hardwoods. Deer and squirrels are not abundant, but these areas are heavily used by beaver, nutria, mink, and raccoon. Cypress-tupelo is the preferred habitat for many species of herons, egrets, ibises, flycatchers, and warblers, and serves as an important breeding and production area for wood ducks.

(8) Actions to Minimize Impacts. See sections II.a.(6) and II.b.(5).

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. Mixing zones for open water disposal for suspended sediment were calculated using average annual values of river flow and suspended sediment concentrations at Simmesport and Morgan City. Results are summarized in Table G-11-29. The mixing zone required to dissipate the discharge of hydraulically dredged material to a level of 1.25 times the average ambient concentration of suspended sediment requires a maximum of 19.8 water surface acres in the Sixmile/Grand Lake area to a minimum of 1.7 water surface acres in the Lower Atchafalaya River. These river mixing zone areas are not considered ecologically significant. Mixing zones for confined disposal areas were not calculated. Effluents from these areas would discharge into the main river channels. Any water quality effects would be very localized and occur in the immediate vicinity of the return flows.

TABLE G-11-29

MIXING ZONE CHARACTERISTICS, MAINTENANCE DREDGING

Parameter	Upper Atchafalaya River*	Lower Atchafalaya River+	Grand/Six Mile Lake+
Ambient Suspended Sediment (mg/l)	296	246	246
1.25 x Suspended Sediment (mg/l)	370	307	307
Flow Required to Dilute Discharge to 1.25 Suspended Sediment Concentration (cfs)	6,119	7,470	7,470
Width of Front Edge of Mixing Zone (ft)	113	73	234
Length of Mixing Zone (ft)	1,935	1,472	6,548
Total Affected Water Surface Acres (acres)	3.2	1.7	19.8
Time of Transport Through Mixing Zone (minutes)	11.0	12.3	54.6

* Based on Data at Simmesport, La.
\+ Based on Data at Morgan City, La.

(a) Depth of Water at Disposal Site. Depths of water and/or location of the discharge, where appropriate, are shown in Table G-11-30. Open water disposal operations would discharge effluents to water with depths ranging from a minimum of 8-12 feet below the LWRP to a maximum of 42-50 feet below the LWRP. Depths of water for return flow from confined areas would range from less than one foot to generally not greater than three feet.

TABLE G-11-30

DEPTH/LOCATION OF MAINTENANCE DREDGING DISPOSAL SITES

Location	Spoil Area	Depth/Location
Three Rivers (Mile 0 Atchafalaya River)	Open Water	12-25 feet below LWRP.
McCrea Landing (Mile 12 Atchafalaya River)	Open Water	8-12 feet below LWRP.
Grand and Sixmile Lake	Open Water	12-20 feet below LWRP.
Berwick Bay Harbor and Berwick Lock Forebay.	Open Water	42-50 feet below LWRP.

(b) Current Velocity, Direction, and Variability at the Disposal Site. Current velocities for main channel disposal would range from one to five feet per second. Flow direction is downstream. Current velocities in confined disposal areas would be generated by inflowing spoil and would quickly diminish with dispersal in the disposal areas.

(c) Degree of Turbulence. The lower Atchafalaya River is naturally turbulent. Disposal in the open river might increase turbulence in the general vicinity of the effluent pipe. Localized turbulence in confined disposal areas would be generated by the disposal operation.

(d) Stratification. Not applicable.

(e) Rate of Discharge. Rates of discharge would generally range from 500-1,000 cubic yards of dredged material per hour.

(f) Ambient Concentration of Constituents of Interest. Elutriate analyses of representative samples at maintenance dredging sites were made in 1975 and 1981. Tables G-11-5, 16, and 28 show native water, elutriate and sediment data in the Atchafalaya River

above Morgan City, the West Access Channel, and the GIWW Alternate Route south of Bayou Sorrel, respectively. Analyses of samples from maintenance dredging sites in the vicinity of Morgan City in the Lower Atchafalaya River were also analyzed, and are given in Tables G-11-21, G-11-22, and G-11-25 through G-11-27. The sampling locations are shown on Plates G-18, and G-27. No heavy metal concentrations were found to increase consistently over ambient water levels. Cadmium, chromium and cyanide were unmeasurable at current (Dec 1980) EPA criteria levels, so their release potentials could not be conclusively determined. On the basis of these data and the expected high dilution capacities of the waters, mixing zone calculations were not considered necessary. During the disposal operations, suspended sediment concentrations would be much higher than the ambient levels. Sediments would also be carriers of heavy metals and pesticides and might provide an indication of potential movement or relocation of pollutants. Suspended sediment concentrations vary from average annual low of 246 mg/l at Morgan City to an average high of 417 mg/l for the water years 1965-1971. Of these concentrations, 7.5 percent were sands and 92.5 percent were silts. The average total sediment load for this period was 46 million tons. Annual suspended sediment loads at Simmesport average 108 million tons, with approximately 23 percent sands and 77 percent silts. Average annual suspended sediment concentration was 550 mg/l.

(g) Dredged Material Characteristics. Dredged materials would vary with specific location, but characteristically are mainly sands with some silt along the main channel and outlets, and are primarily silt and clay with some sand along the distributaries and the GIWW Alternate Route. The representative dredged material sample sites indicate a range of 3 percent to 97 percent sands. Total average annual amounts of dredged material for dredging sites are shown in Table G-11-24 and total 2,170,000 cubic yards. Of this total, approximately 1,400,000 cubic yards would be placed in confined spoil areas and 700,000 cubic yards would be disposed of in the Atchafalaya River channel. Settling within the confined disposal areas would be rapid for sands, however, significant portions of silts and clays would re-enter the main channel in the effluent. Spoil placed in the main channel would tend to remain in suspension, with sand settling out at some distance below the discharge and silts remaining in suspension.

(h) Number of Discharge Actions Per Unit of Time. Dredging would occur primarily during the summer and fall months (moderate to low flow conditions) and would extend over the project life. The rate of discharge would depend on the size of dredge and operating conditions, but would be in the general range of 500-1,000 cubic yards of dredged material per hour.

(2) Determination of Compliance with Applicable Water Quality Standards. The Louisiana State Water Quality Criteria for the Atchafalaya River are indicated in Table G-11-6. The general criteria

dealing with esthetics, color, floating, suspended and settleable solids, taste and odor, toxic substances, oil and grease, foaming or frothing material, nutrients, and turbidity are also applicable. The only category of toxic substances determined to be applicable to dredged material pursuant to Section 307 of the Clean Water Act of 1977 is polychlorinated biphenyls. This class of chemicals was not detected at the Atchafalaya River representative sampling sites in 1981, although, analysis of bottom sediments during 1975 in the lower river indicated PCB's do occur in the project area. Chemical analyses of samples from open water dredge disposal sites did not detect mobilization of the PCB's into the water column. PCB's are not expected to create water or sediment quality problems on the lower Atchafalaya River. Based on the available ambient water quality data, elutriate analyses, generally sandy composition of open water disposed materials, limited extent of mixing zones, and the short duration of the construction work period at any particular site, applicable water quality standards would not be exceeded outside the estimated mixing zones nor would any ephemeral increases in water column chemical constituents associated with dredging in the Atchafalaya River be ecologically significant. The bioavailability of toxic substances in effluents from containment areas cannot be accurately estimated from water, sediment and elutriate analyses. Those areas that would receive material primarily composed of silt and clay should be controlled such that their effluent releases would be comparable in turbidity to the receiving water body.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No effects.

(b) Recreational and Commercial Fisheries. See section II.c.(3). The loss of about 5,800 acres of aquatic and seasonally flooded terrestrial habitat over the project life would adversely affect recreational and commercial fisheries to an unknown degree. The disposal areas would revegetate and furnish organic detritus to the aquatic food web, however, they would be flooded less frequently than at present. These areas could be used by aquatic and semi-aquatic animals during high water periods. Overall effects, considering the type and quantity of aquatic habitat in the basin and the rapidly changing (from aquatic to terrestrial) character of the areas proposed for disposal sites, are not significant.

(c) Water Related Recreation. No significant effects.

(d) Esthetics. Disposal areas would be unsightly until revegetation occurs. Loss of some 300 acres of esthetically-pleasing cypress-tupelo habitat would occur. Turbidity plumes would be visible downstream of dredging and open water disposal sites.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. No effects.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. The proposed maintenance dredging is part of an overall comprehensive plan for the Atchafalaya Basin Floodway System. The plan would accomplish flood control and navigation objectives, which are highly important in the Lower Mississippi Valley, and provide for preservation and enhancement of the very significant fish, wildlife, and other natural resources of the basin. Overall, then, the plan would result in preservation and enhancement of significant portions of the basin's aquatic environment. The plan cannot, however, prevent large-scale changes in habitat, from aquatic to terrestrial, as the maturation of the Atchafalaya River continues. The direct effects of the disposal will result in the loss or modification of 300 acres of cypress-tupelo, 2,530 acres of mid-to-late successional bottomland hardwoods, and 2,970 acres of early successional bottomland hardwoods over the project life. This compares to 451,000, 332,000, and about 100,000 acres, respectively, of these habitat types within the project-affected area (Table 6-7, page EIS-157, Vol. 1). On a percentage basis, construction of the entire project would cause a loss of 1.3, 2.7 and 6.0 percent respectively, of these habitat types. Other disposals of dredged or fill material as part of the overall plan for the Atchafalaya Basin Floodway System would add to the cumulative loss of habitat, but total loss and/or conversion of this amount of habitat is considered acceptable in the overall public interest.

h. Determinations of Secondary Effects on the Aquatic Ecosystem. The loss and/or alteration of 5,800 acres of vegetated wetland habitat would result in a reduction of organic detritus available to the aquatic ecosystem.

III. FINDING OF COMPLIANCE FOR MAINTENANCE DREDGING.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. There are no practicable alternative sites which would accomplish the objectives of the maintenance dredging and have less adverse impact on the aquatic ecosystem. The sizes of sites would be kept to the minimum, consistent with storage required for adequate settlement of solids, and effluent from the confined sites would be directed to adjacent channels where effects on the aquatic ecosystem would be minimal.

c. Use of the disposal sites would not be expected to violate state water quality standards to a significant degree. There may be

some associated increases in turbidity and decreases in dissolved oxygen, but these would be localized and temporary.

d. Discharges would comply with applicable toxic effluent standards and prohibitions under Section 307 of the Clean Water Act.

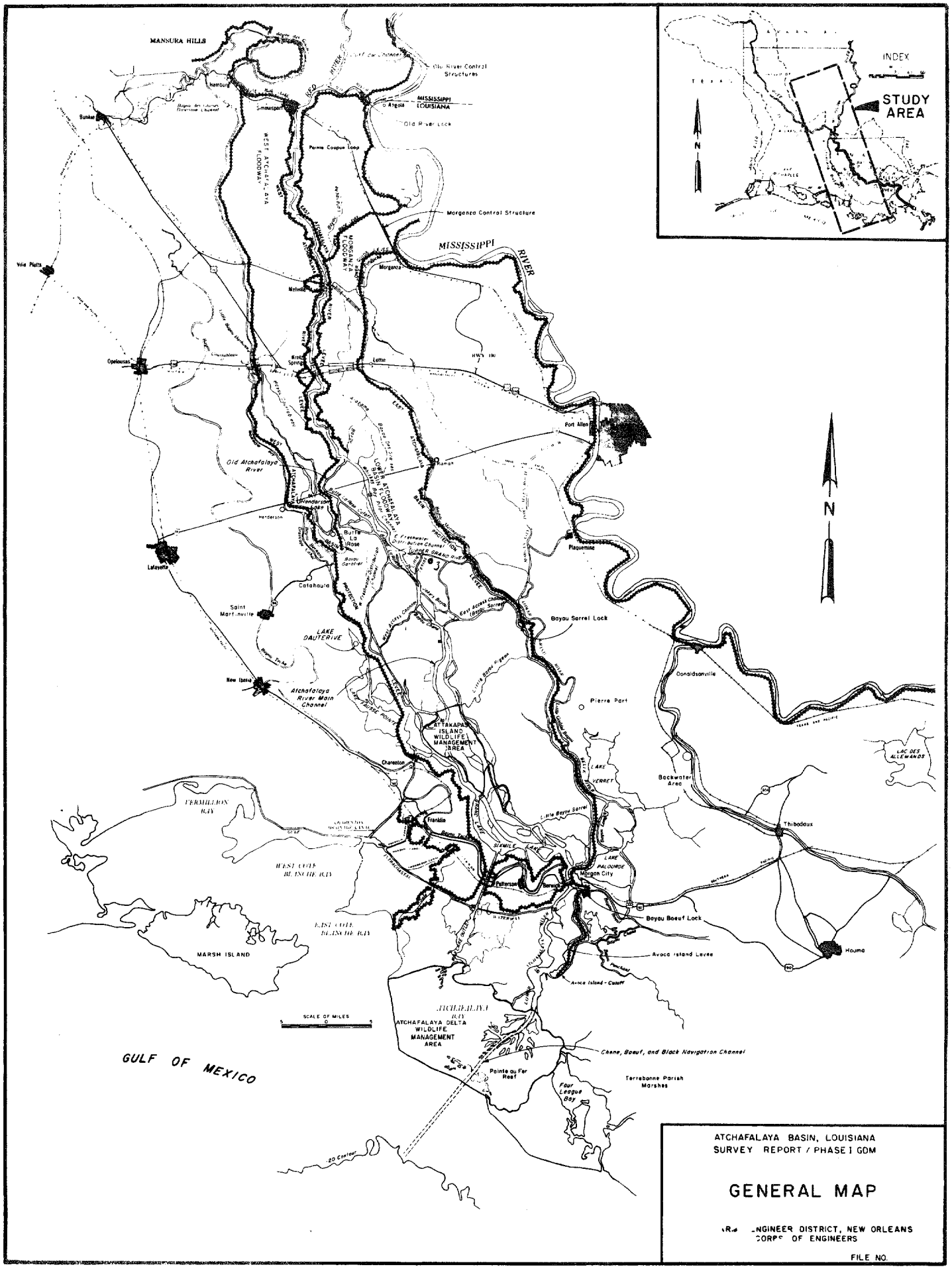
e. The proposed discharges would not jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of critical habitat.

f. There are no marine sanctuaries affected by this project feature.

g. The proposed discharges would not result in unacceptable adverse effects on human health and welfare including municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, or special aquatic sites. The discharges would likewise not result in unacceptable adverse effects on life stages of aquatic or semi-aquatic organisms, aquatic ecosystem diversity, productivity, and stability, or recreational, esthetic, and economic values.

h. Confined disposal sites would be confined to the smallest practicable area and effluents returned to river channels.

i. On the basis of the guidelines the proposed disposal sites for the discharge of dredged material are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystems.



ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM

GENERAL MAP

...NGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE G-1

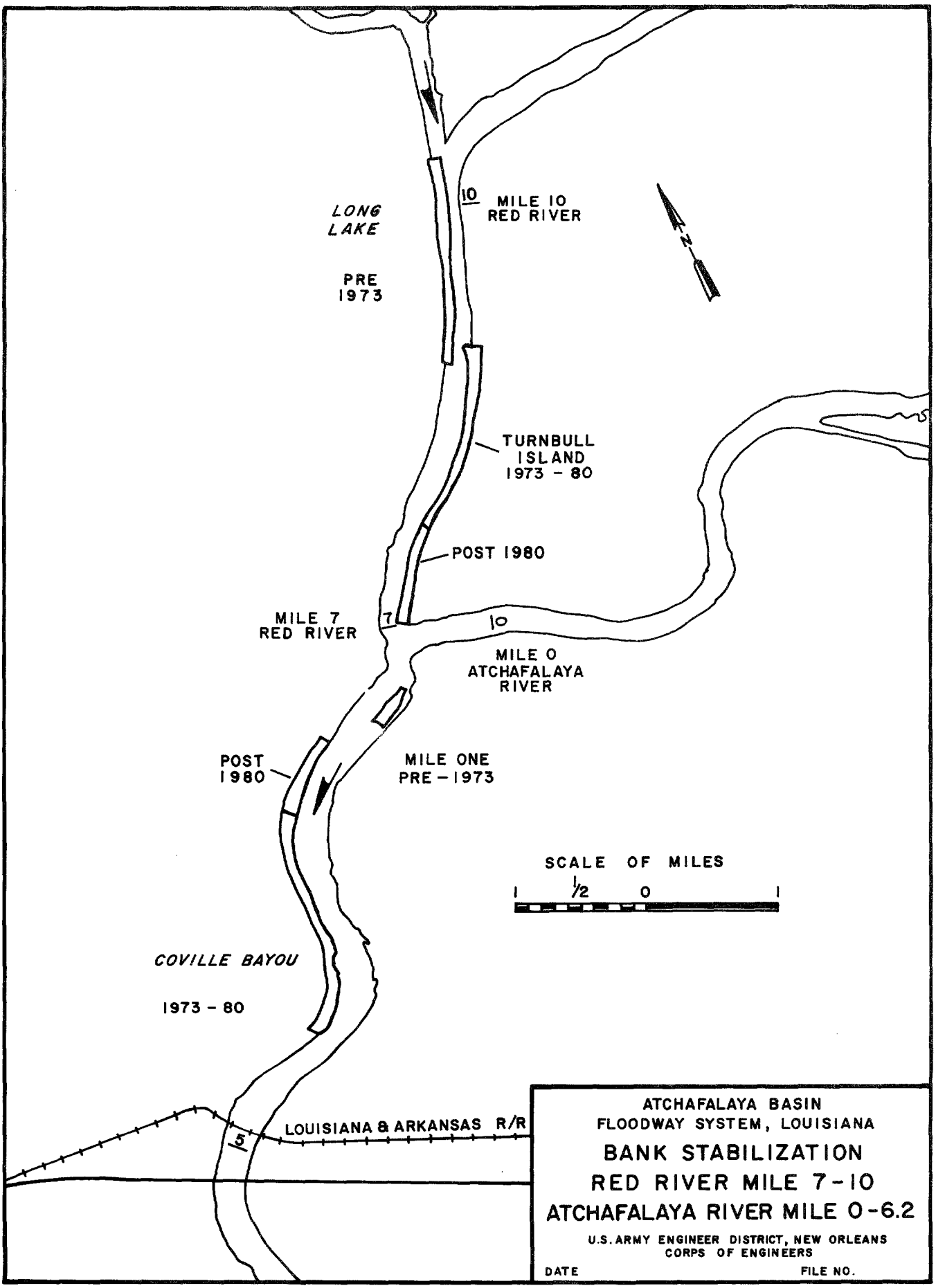
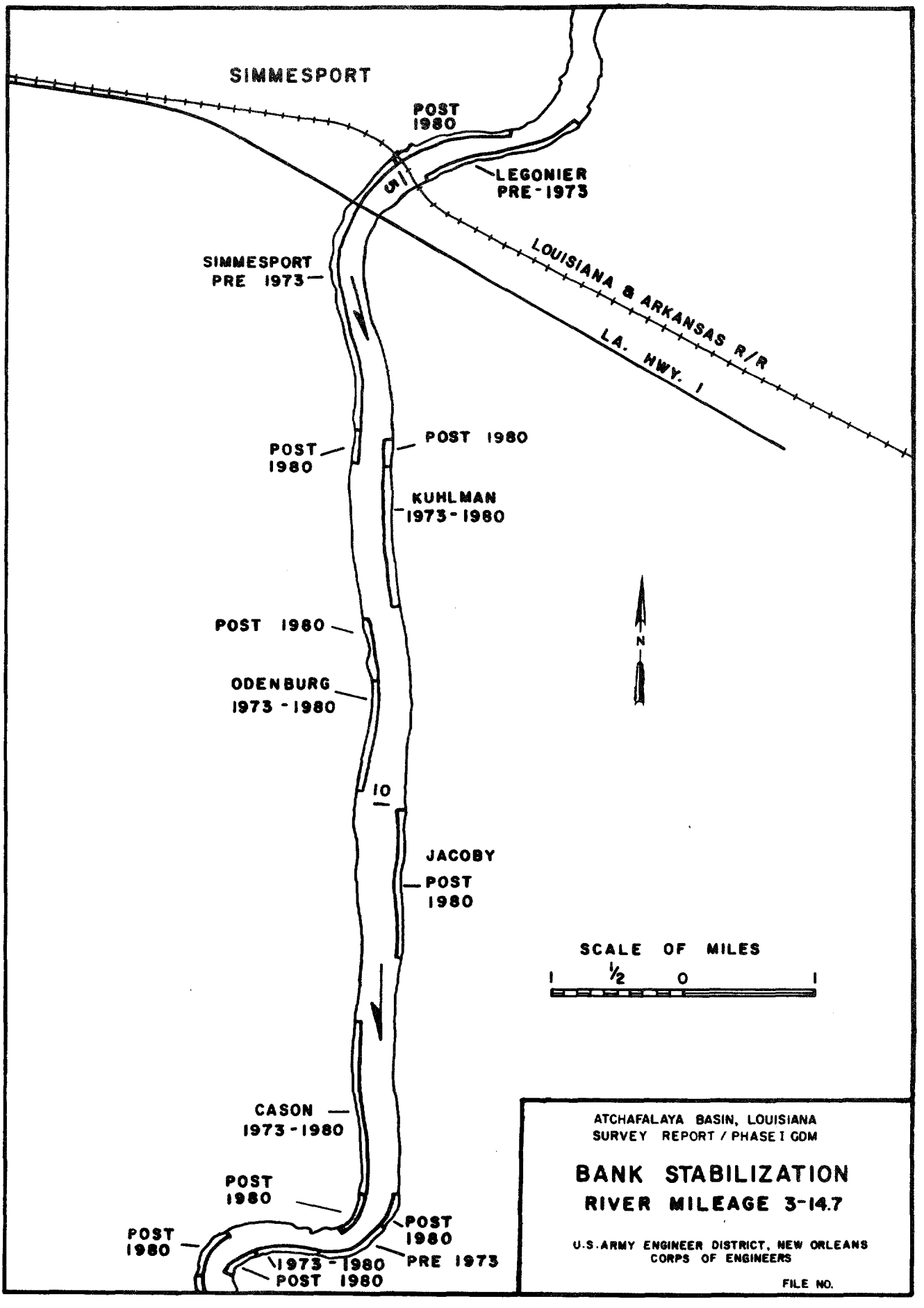

LONG LAKE
PRE 1973
10
MILE 10 RED RIVER
N
TURNBULL ISLAND 1973 - 80
POST 1980
MILE 7 RED RIVER
7
10
MILE 0 ATCHAFALAYA RIVER
POST 1980
MILE ONE PRE - 1973
SCALE OF MILES
1 1/2 0 1
COVILLE BAYOU
1973 - 80
LOUISIANA & ARKANSAS R/R
5
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RED RIVER MILE 7 - 10
ATCHAFALAYA RIVER MILE 0 - 6.2
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-2



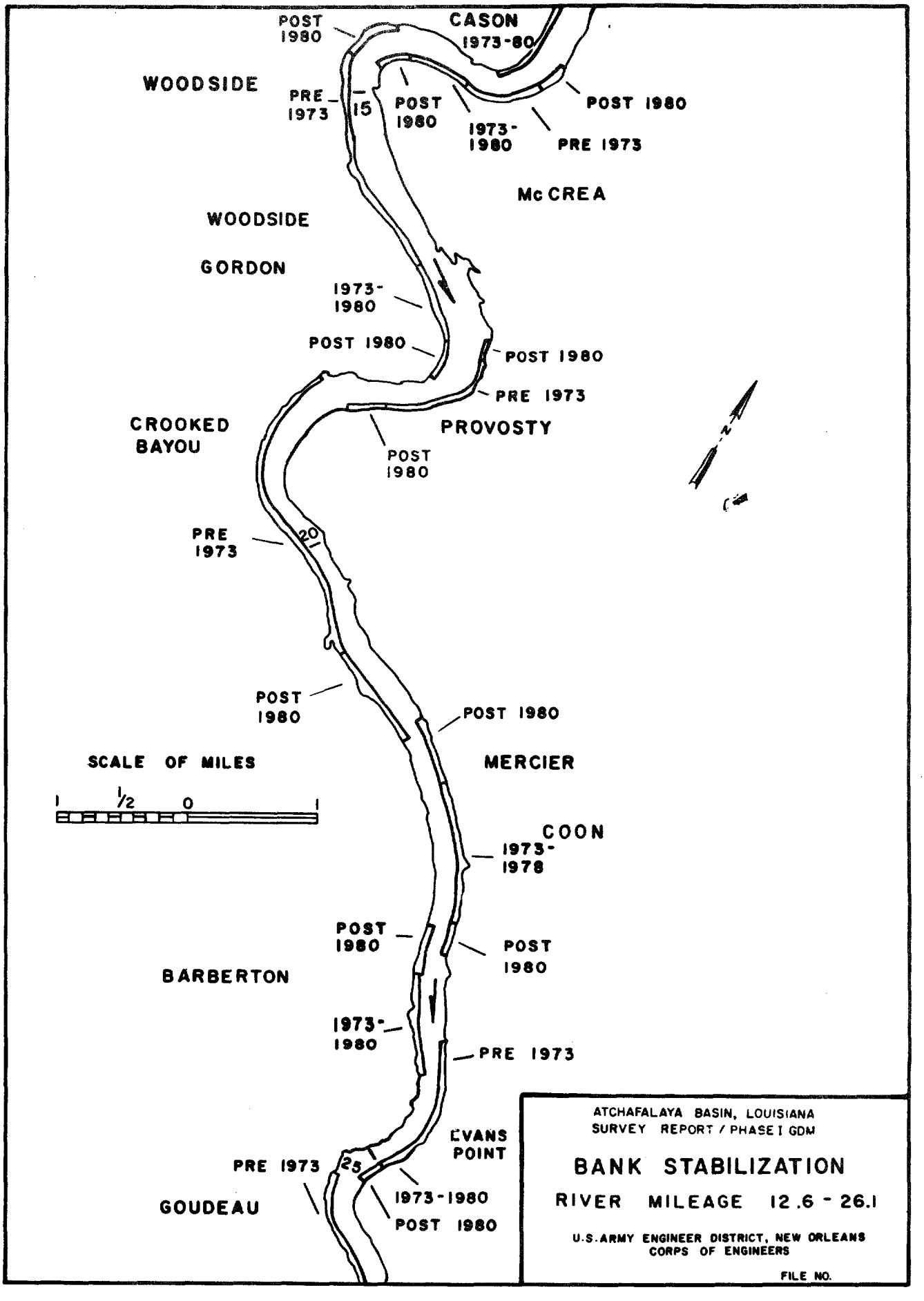
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM

BANK STABILIZATION
RIVER MILEAGE 3-14.7

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE G-3



ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM

BANK STABILIZATION

RIVER MILEAGE 12.6 - 26.1

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

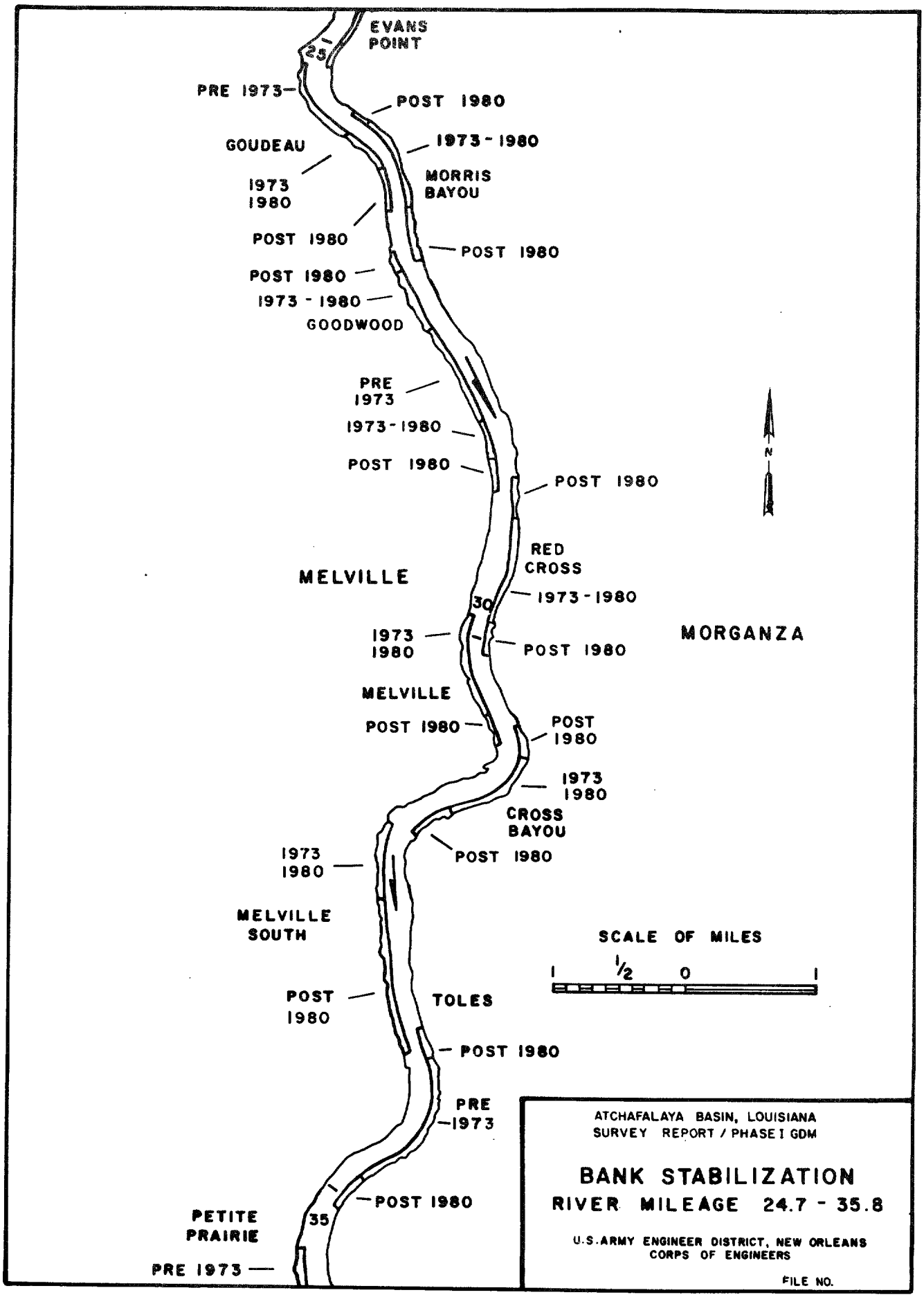

EVANS POINT
25
PRE 1973
POST 1980
GOUDEAU
1973 - 1980
1973
1980
MORRIS BAYOU
POST 1980
POST 1980
POST 1980
1973 - 1980
GOODWOOD
PRE 1973
1973 - 1980
POST 1980
POST 1980
N
RED CROSS
MELVILLE
30
1973 - 1980
1973
1980
POST 1980
MORGANZA
MELVILLE
POST 1980
POST 1980
1973
1980
CROSS BAYOU
1973
1980
POST 1980
MELVILLE SOUTH
SCALE OF MILES
1 1/2 0 1
POST 1980
TOLES
POST 1980
PRE 1973
POST 1980
35
PETITE PRAIRIE
PRE 1973
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM
BANK STABILIZATION
RIVER MILEAGE 24.7 - 35.8
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE G-5

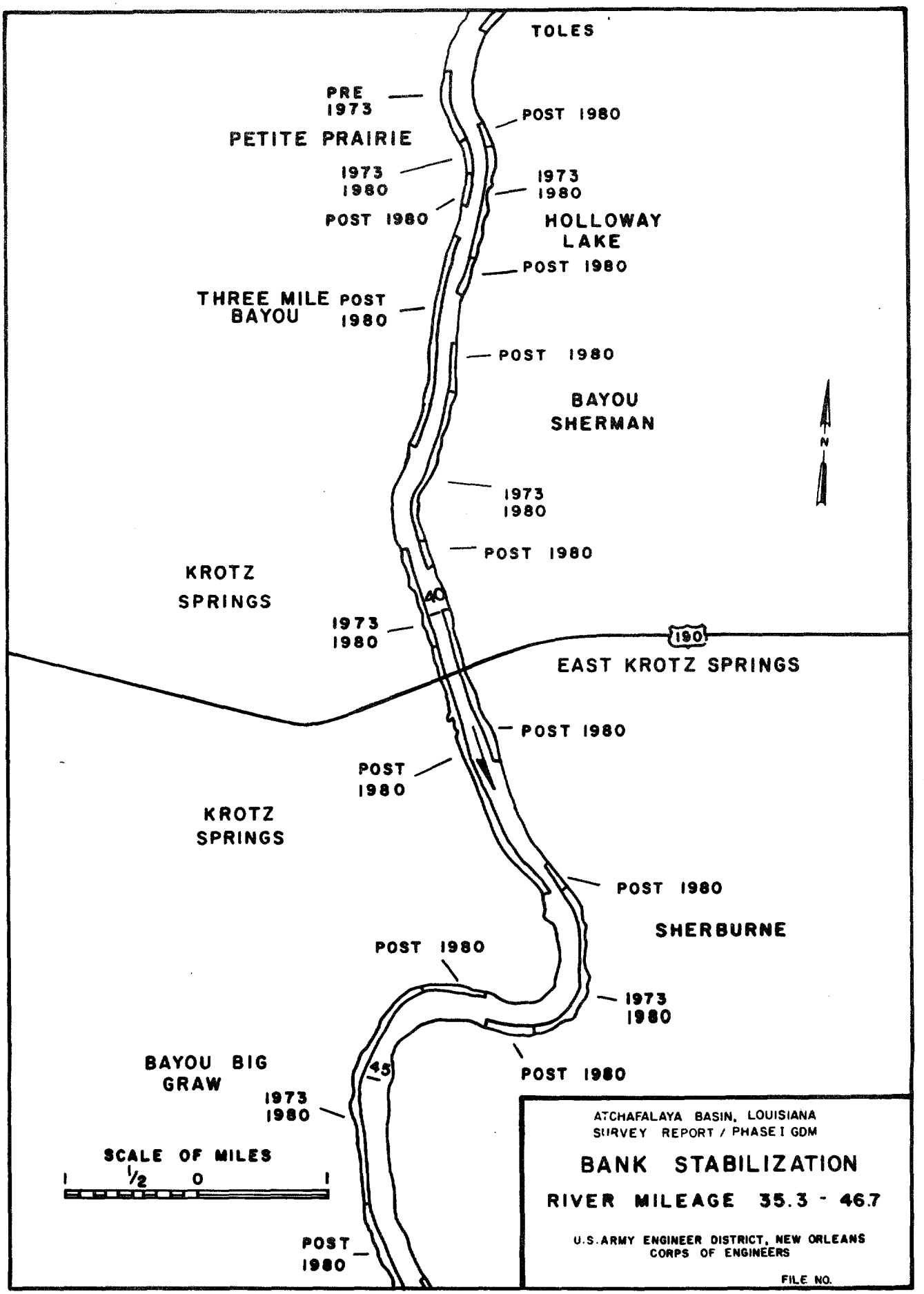

TOLES
PRE 1973
POST 1980
PETITE PRAIRIE
1973 1980
POST 1980
1973 1980
HOLLOWAY LAKE
POST 1980
THREE MILE BAYOU
POST 1980
POST 1980
BAYOU SHERMAN
N
1973 1980
POST 1980
KROTZ SPRINGS
40
1973 1980
190
EAST KROTZ SPRINGS
POST 1980
POST 1980
KROTZ SPRINGS
POST 1980
SHERBURNE
POST 1980
1973 1980
BAYOU BIG GRAW
45
POST 1980
1973 1980
SCALE OF MILES
1 1/2 0 1
POST 1980
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM
BANK STABILIZATION
RIVER MILEAGE 35.3 - 46.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE G-6

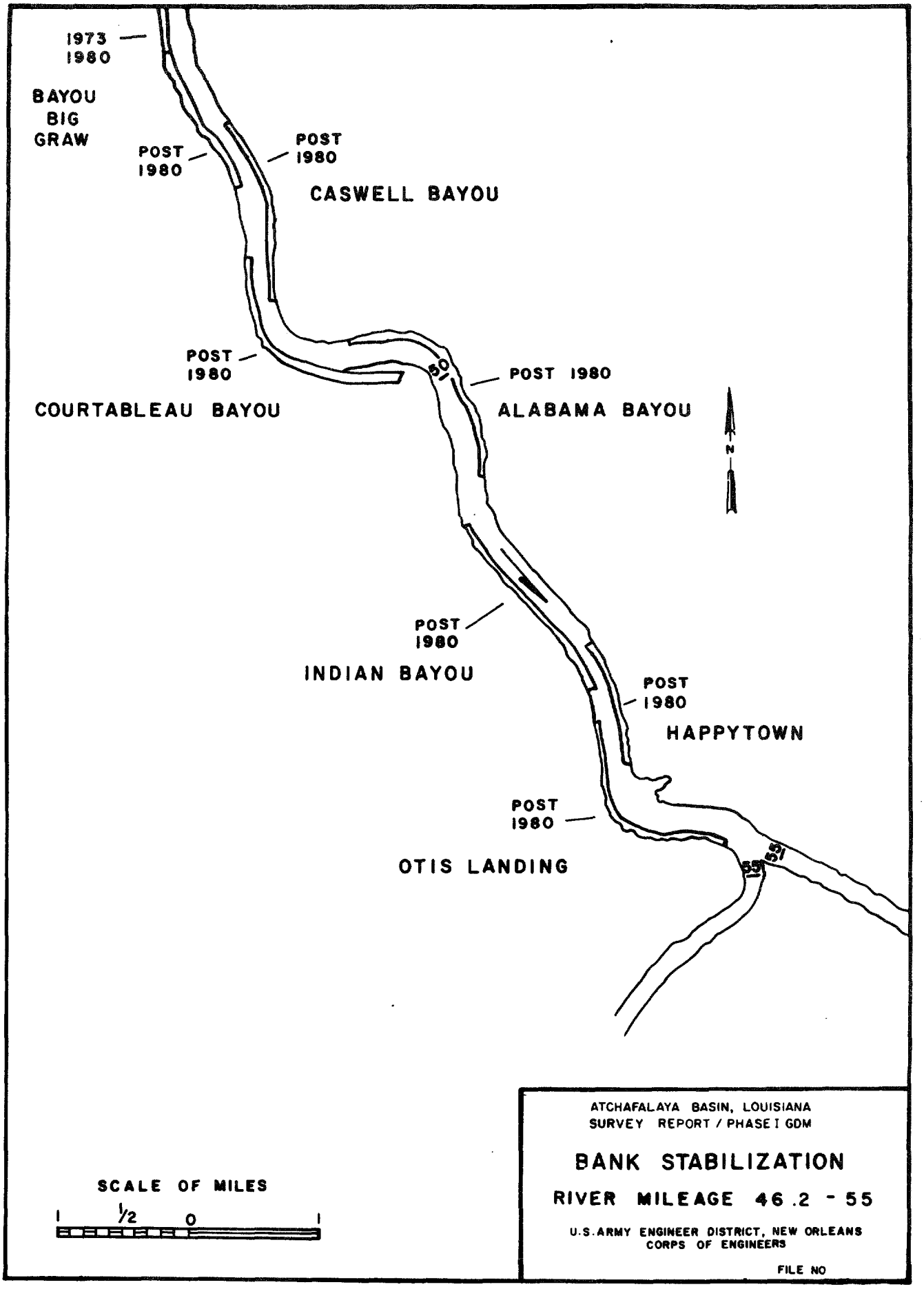
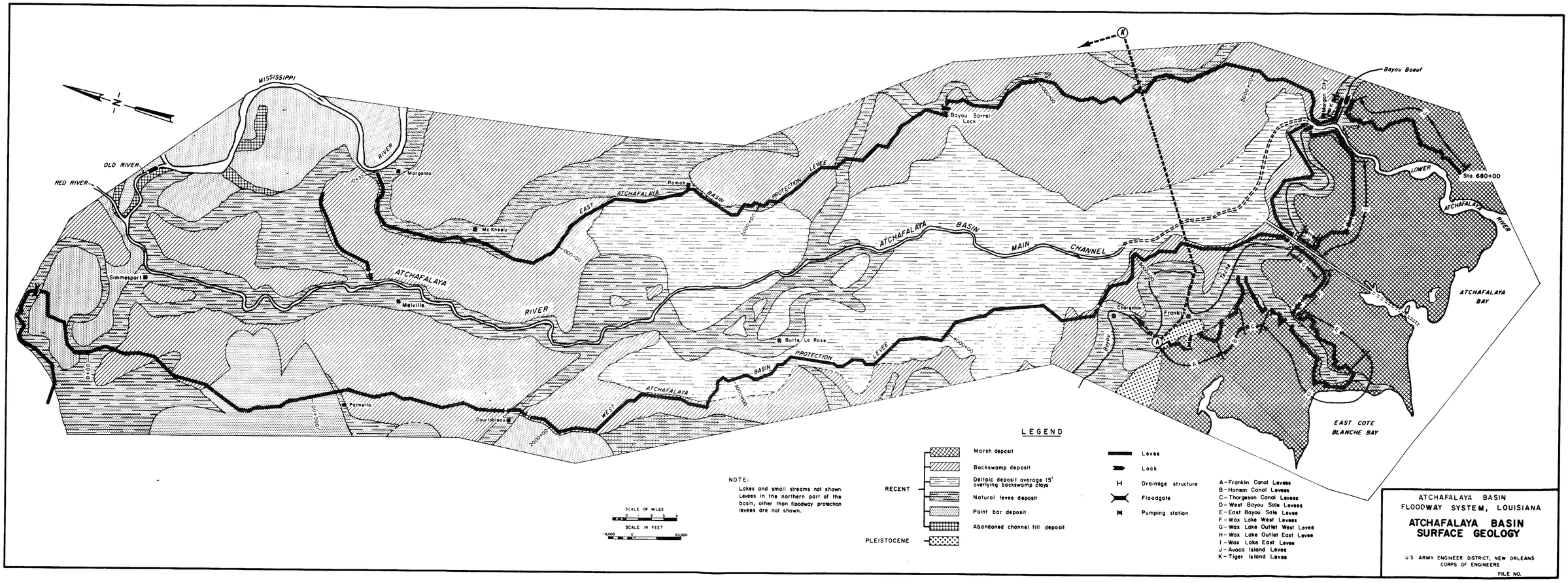

1973
1980
BAYOU
BIG
GRAW
POST
1980
POST
1980
CASWELL BAYOU
POST
1980
50
POST 1980
COURTABLEAU BAYOU
ALABAMA BAYOU
N
POST
1980
INDIAN BAYOU
POST
1980
HAPPYTOWN
POST
1980
OTIS LANDING
55
51
SCALE OF MILES
1
1/2
0
1
ATCHAFALAYA BASIN, LOUISIANA
SURVEY REPORT / PHASE I GDM
BANK STABILIZATION
RIVER MILEAGE 46.2 - 55
U.S.ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO

PLATE G-7



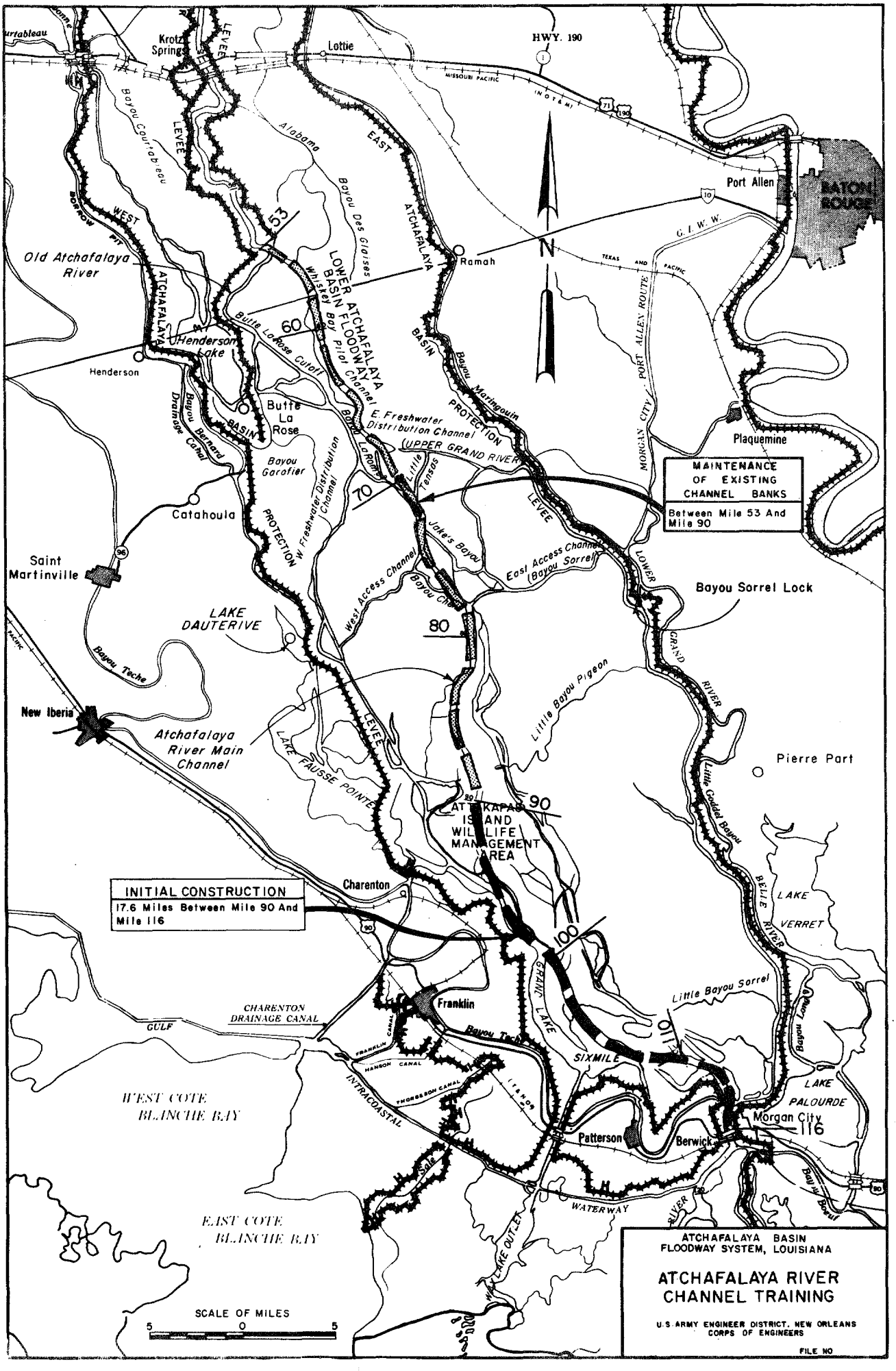
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN SURFACE GEOLOGY

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE G-8


HWY. 190
Krotz Springs
Lottie
MISSOURI PACIFIC
(N O T & M)
Port Allen
BATON ROUGE
G. I. W. W.
TEXAS AND PACIFIC
Bayou Courtableau
LEVEE
Alabama
Bayou Des Glaises
EAST
ATCHAFALAYA
BASIN
PROTECTION
LEVEE
WEST
ATCHAFALAYA
BORROW PIT
Old Atchafalaya River
Ramah
LOWER ATCHAFALAYA BASIN FLOODWAY
Whiskey Bay Pilot Channel
Butte La Rose Cutoff
Henderson Lake
Henderson
Bayou Bernard Drainage Canal
Butte La Rose
Bayou Garofier
W. Freshwater Distribution Channel
E. Freshwater Distribution Channel
(UPPER GRAND RIVER)
Bayou Maringouin
Little Tensas
Bayou La Rome
Catahoula
Saint Martinville
Jake's Bayou
East Access Channel (Bayou Sorrel)
West Access Channel
Bayou Chene
LAKE DAUTERIVE
Bayou Teche
New Iberia
Atchafalaya River Main Channel
LAKE FAUSSE POINTE
Little Bayou Pigeon
Pierre Part
Little Goddel Bayou
BELLE RIVER
LAKE VERRET
Bayou Long
LAKE PALOURDE
Morgan City
Little Bayou Sorrel
Bayou Boeuf
Bayou Sorrel Lock
MORGAN CITY - PORT ALLEN ROUTE
Plaquemine
MAINTENANCE OF EXISTING CHANNEL BANKS
Between Mile 53 And Mile 90
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
INITIAL CONSTRUCTION
17.6 Miles Between Mile 90 And Mile 116
Charenton
Franklin
CHARENTON DRAINAGE CANAL
GULF
FRANKLIN CANAL
HANSON CANAL
THORESSON CANAL
INTRACOASTAL
GRAND LAKE
SIXMILE
Patterson
Berwick
WATERWAY
RIVER
WAX LAKE OUTLET
WEST COTE BLANCHE BAY
EAST COTE BLANCHE BAY
53
60
70
80
90
100
110
116
SCALE OF MILES
5 0 5
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA RIVER CHANNEL TRAINING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO

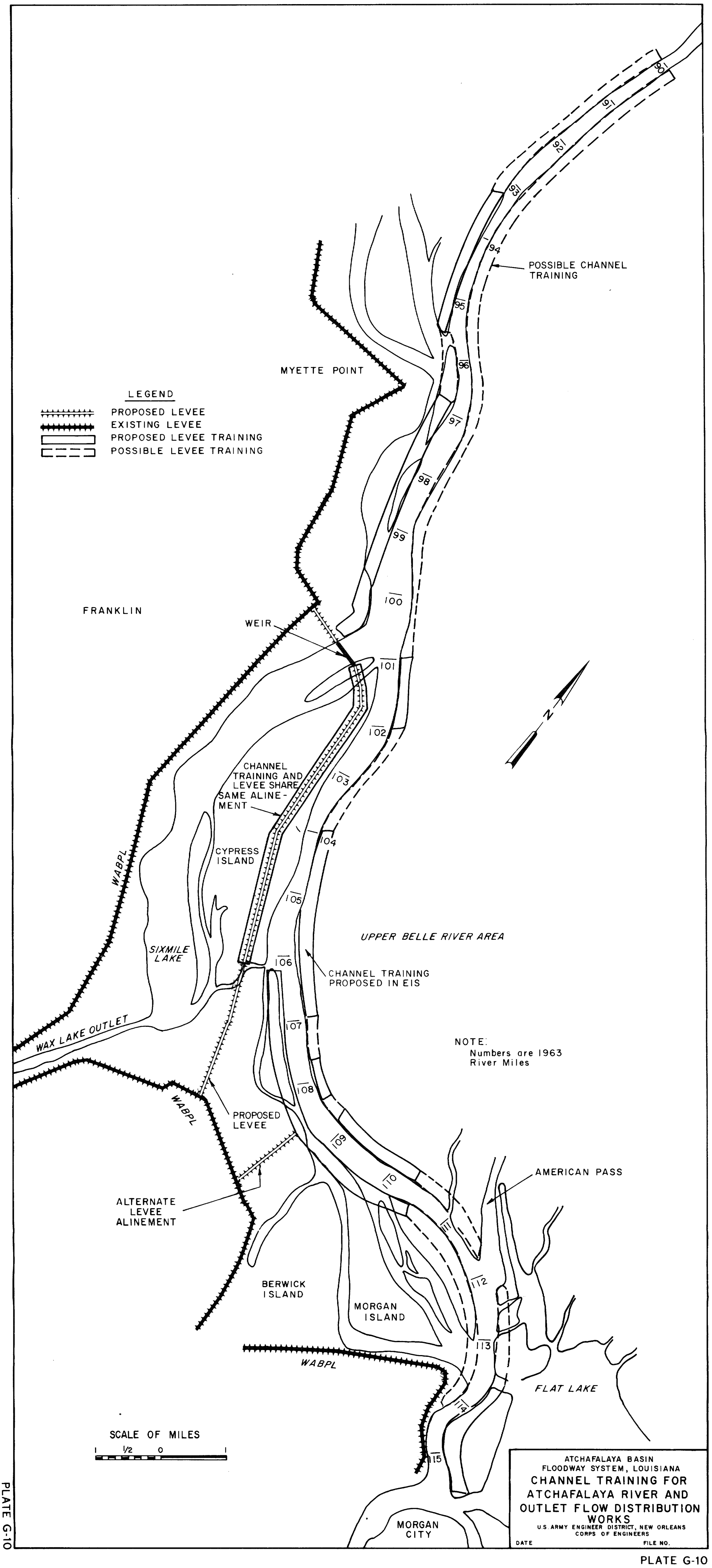
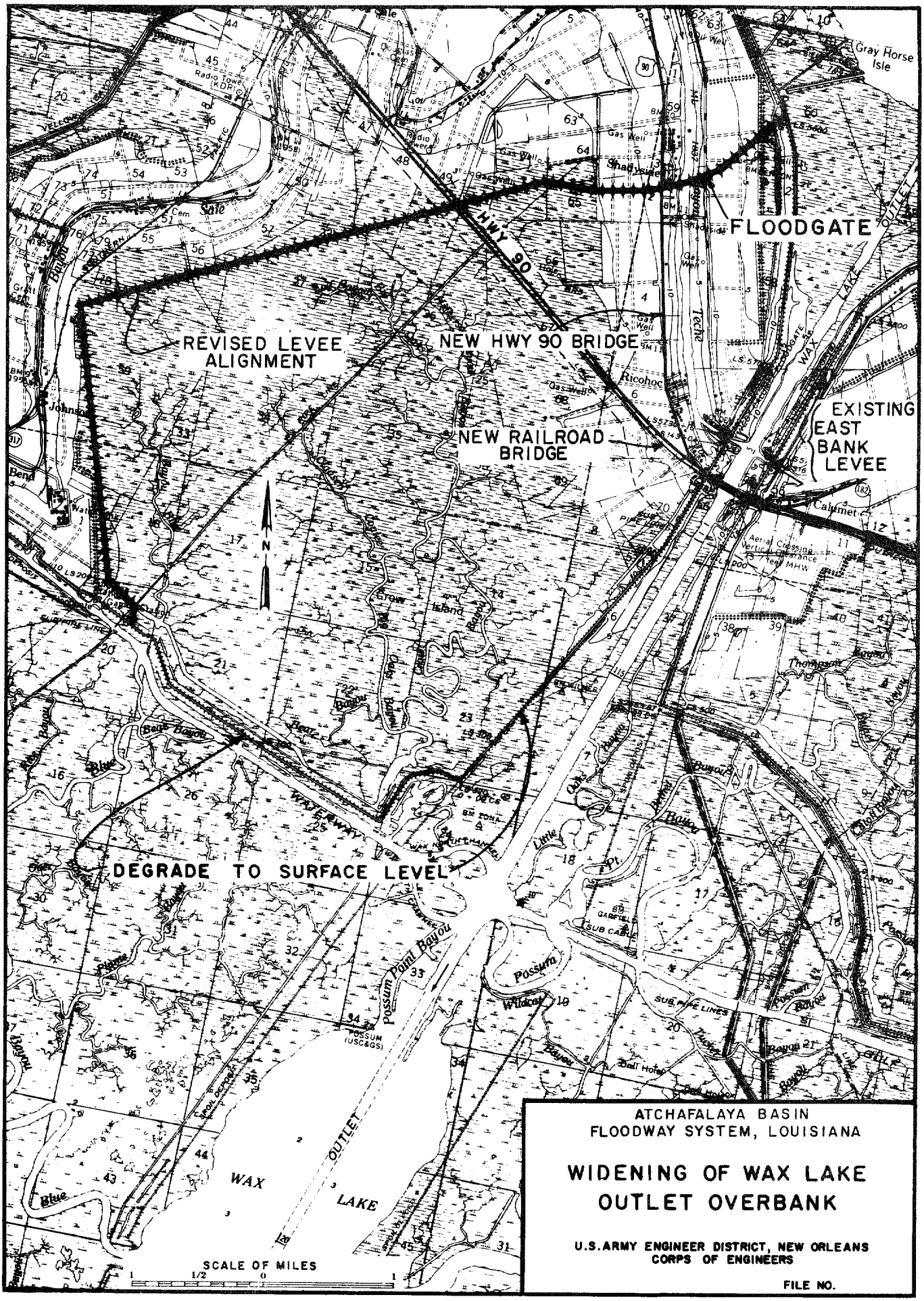


PLATE G-10

PLATE G-10



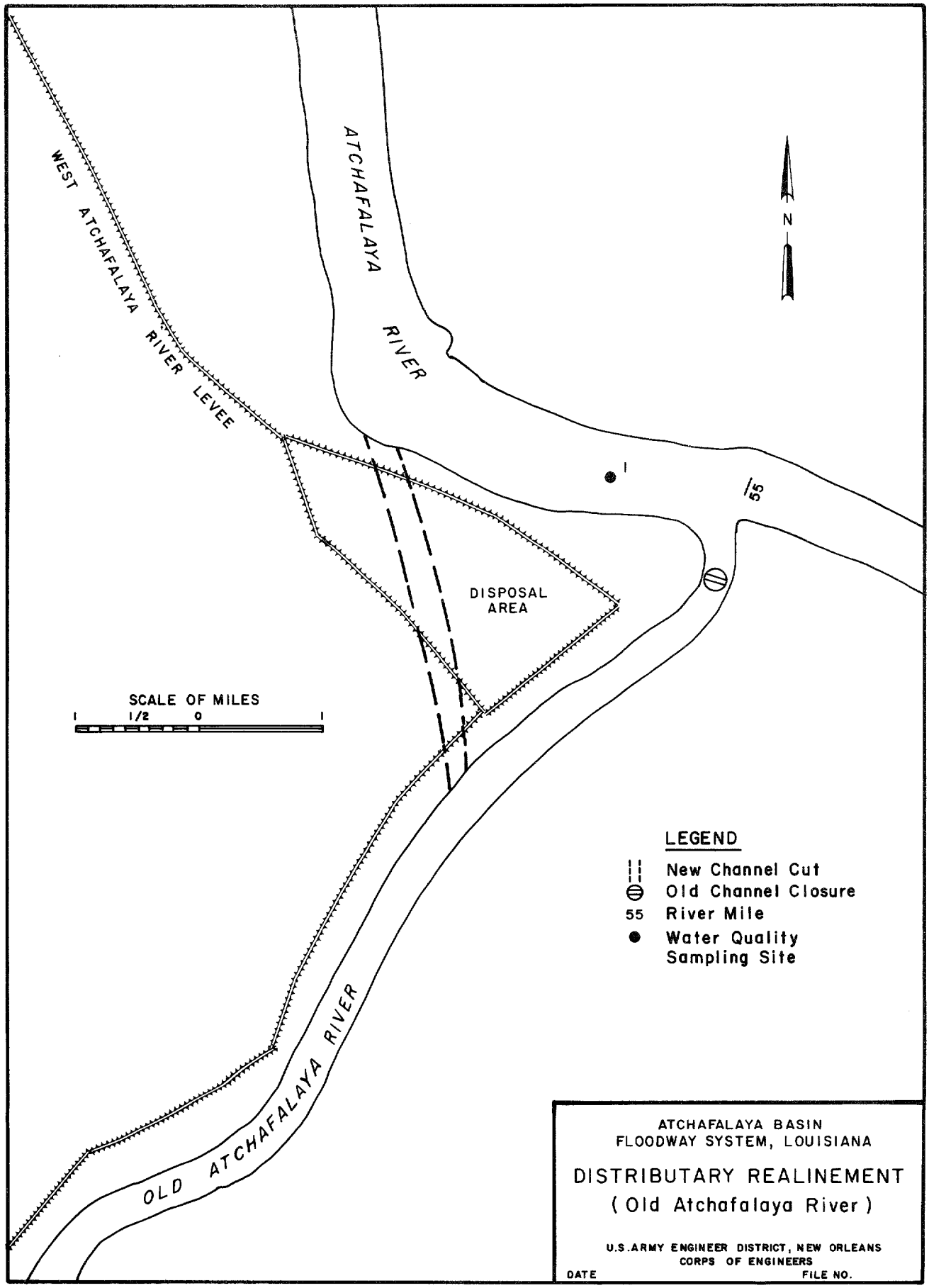
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

WIDENING OF WAX LAKE OUTLET OVERBANK

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE G-11



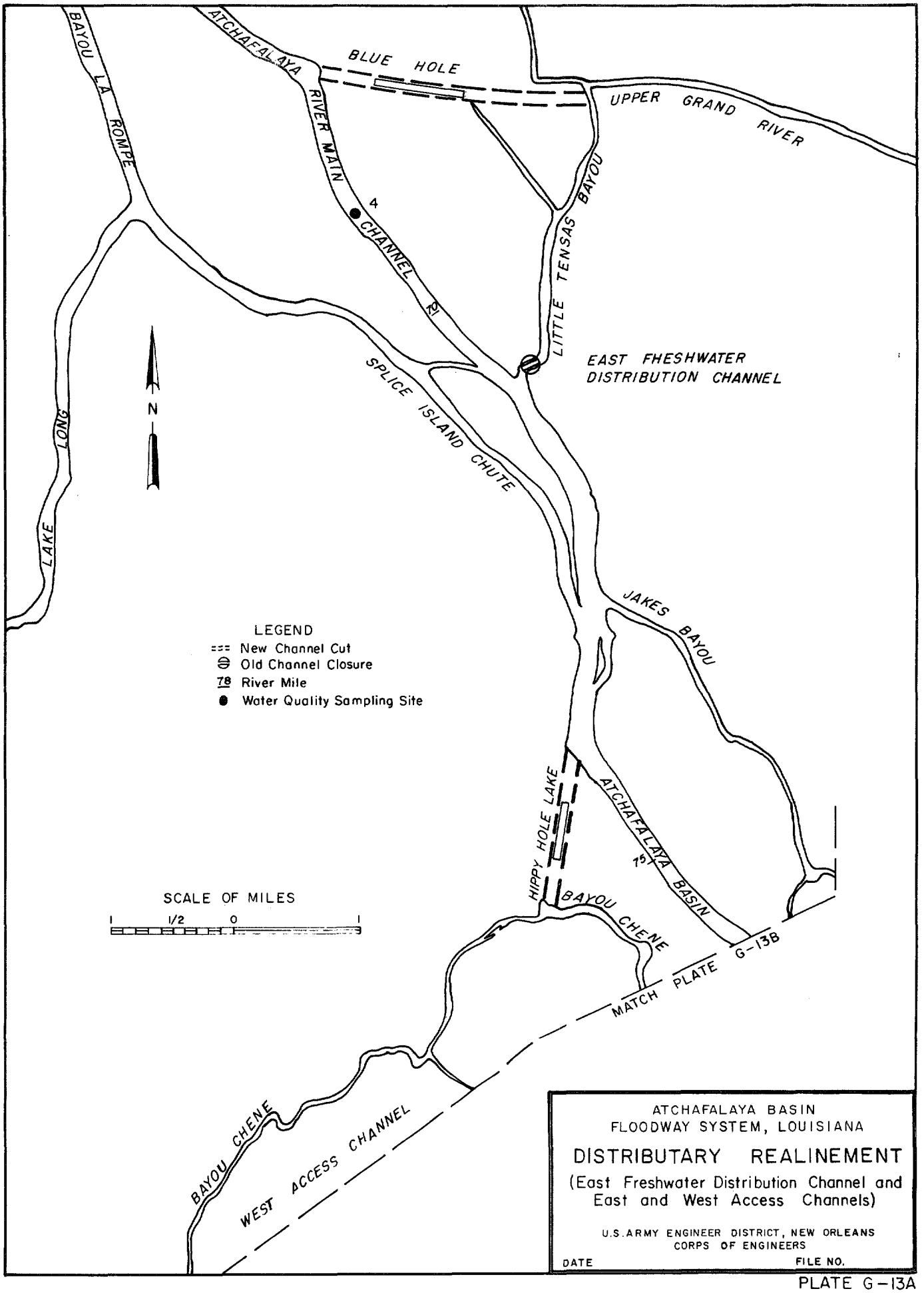
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

DISTRIBUTARY REALINEMENT
(Old Atchafalaya River)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-12



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

DISTRIBUTARY REALINEMENT

(East Freshwater Distribution Channel and East and West Access Channels)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-13A

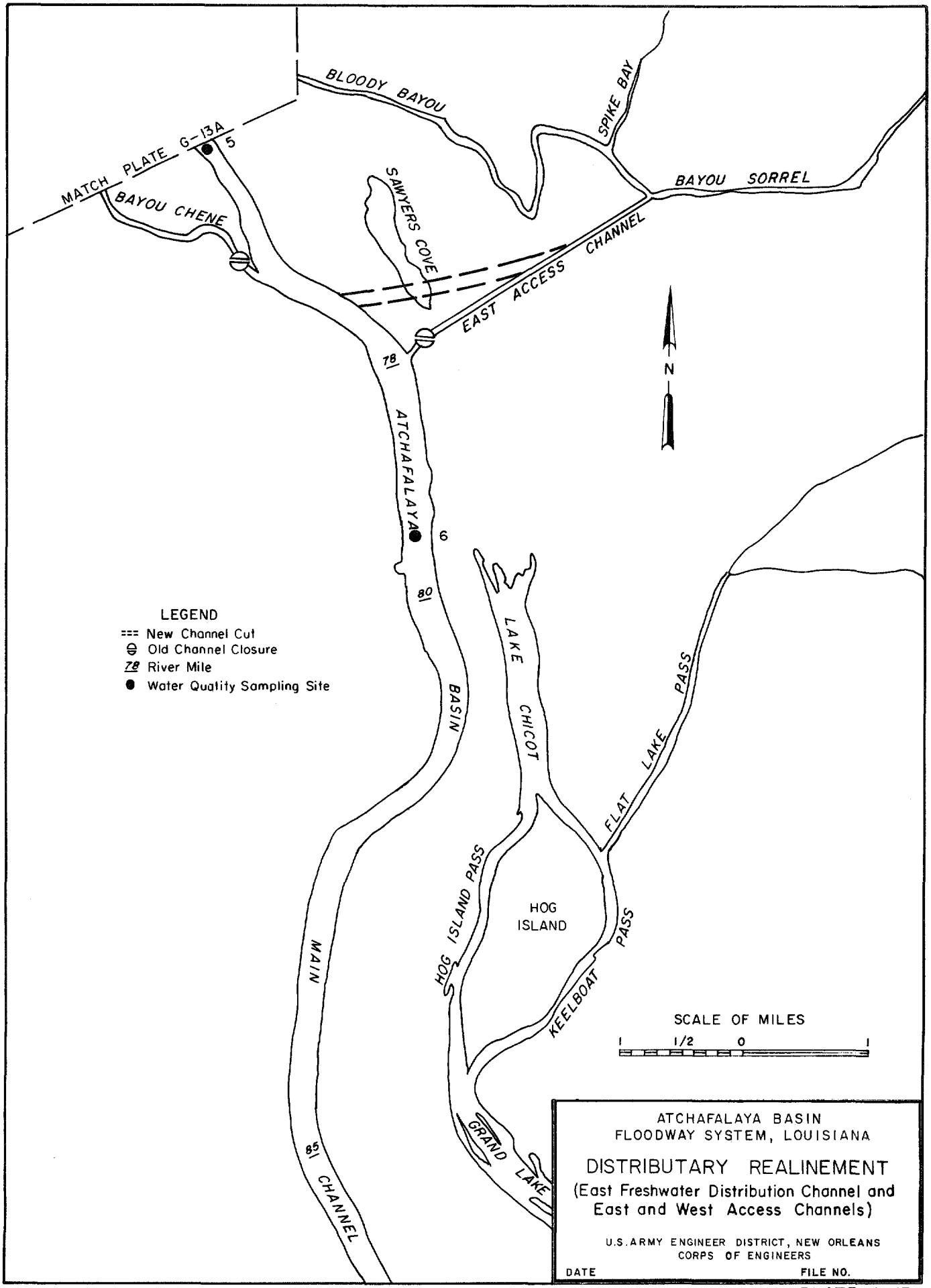
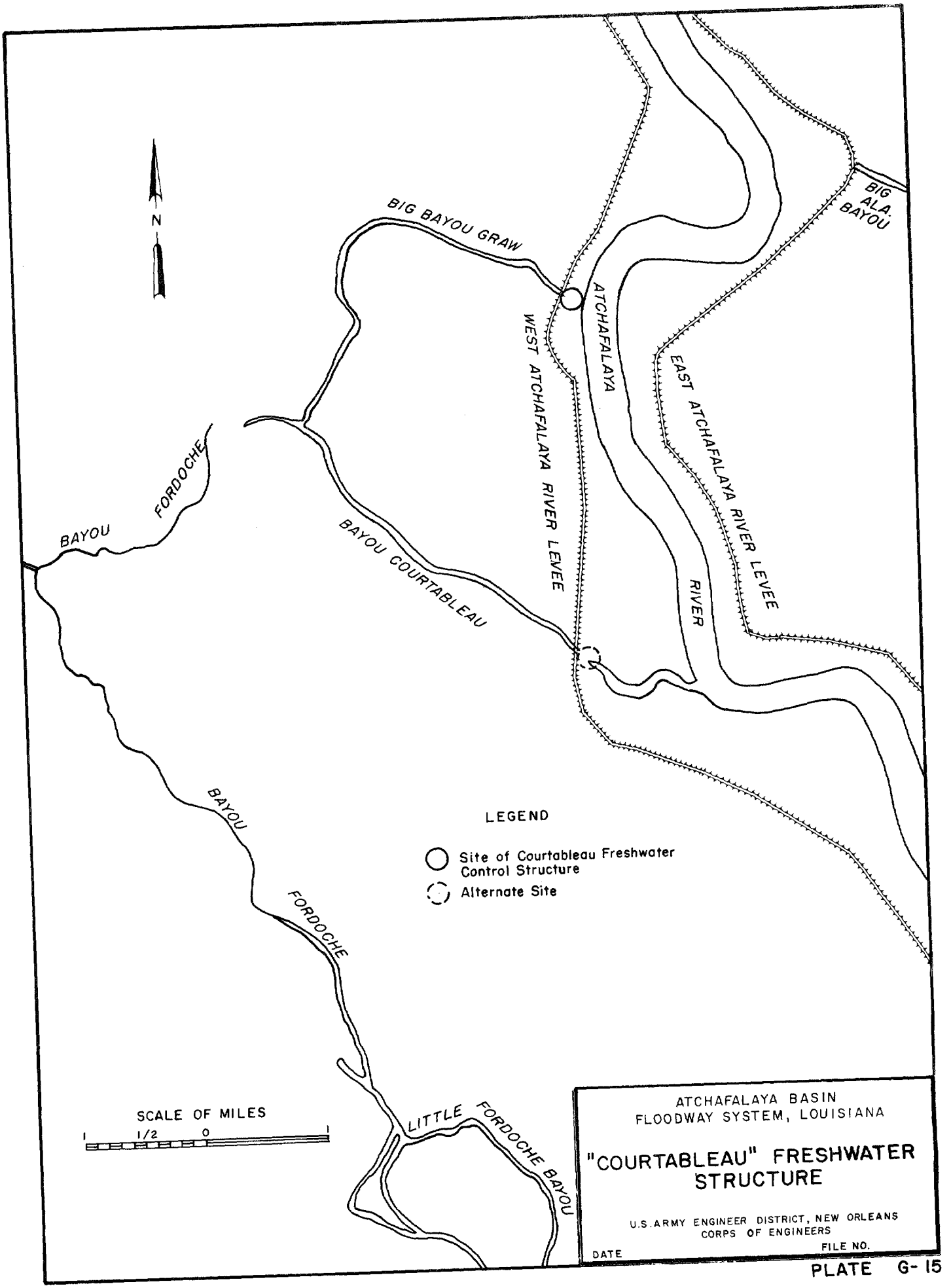

BLOODY BAYOU
SPIKE BAY
MATCH PLATE G-13A
5
BAYOU CHENE
SAWYERS COVE
BAYOU SORREL
EAST ACCESS CHANNEL
N
78
ATCHAFALAYA
6
80
LAKE CHICOT
BASIN
FLAT LAKE PASS
HOG ISLAND PASS
HOG ISLAND
KEELBOAT PASS
MAIN
81
CHANNEL
GRAND LAKE
LEGEND
New Channel Cut
Old Channel Closure
78 River Mile
Water Quality Sampling Site
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
DISTRIBUTARY REALINEMENT
(East Freshwater Distribution Channel and
East and West Access Channels)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-13B

INLET STRUCTURE INTO WANDA CANAL
BAYOU EUGENE CLOSURE AND BOAT ROLLOVER STRUCTURE
SI BON CANAL CLOSURE AND BOAT ROLLOVER STRUCTURE
BOAT ROLLOVER STRUCTURE
OUTLET STRUCTURE
IMPROVED BOAT LAUNCH
ACCESS CANAL
INDICATED OPENING IN SPOIL BANK OR LEVEES FOR IMPROVEMENT OF WATER CIRCULATION
LEVEE OR CLOSURES AS NEEDED
OUTLET STRUCTURE
TAYLOR POINT CLOSURE
OUTLET STRUCTURE
West Access Channel
Florida Gas Canal
Wanda Canal
Si Bon Canal
ARM OF GRAND LAKE
LAKE FAUSSE POINTE
ATCHAFALAYA BASIN MAIN CHANNEL
GRAND LAKE
LAKE CHICOT
HOG ISLAND
IBERIA PARISH
ST MARY PARISH
ST MARTIN PARISH
Charenton
Baldwin
Jeanerette Oil and Gas Field
Charenton Oil and Gas Field
Oaklawn Manor
Camperdown
Taylor Point
N
SCALE 1:62,500
1 1/2 0 1 Miles
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
PROPOSED FEATURES OF BUFFALO COVE MANAGEMENT UNIT
U.S.ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
FILE NO.

PLATE G-14



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

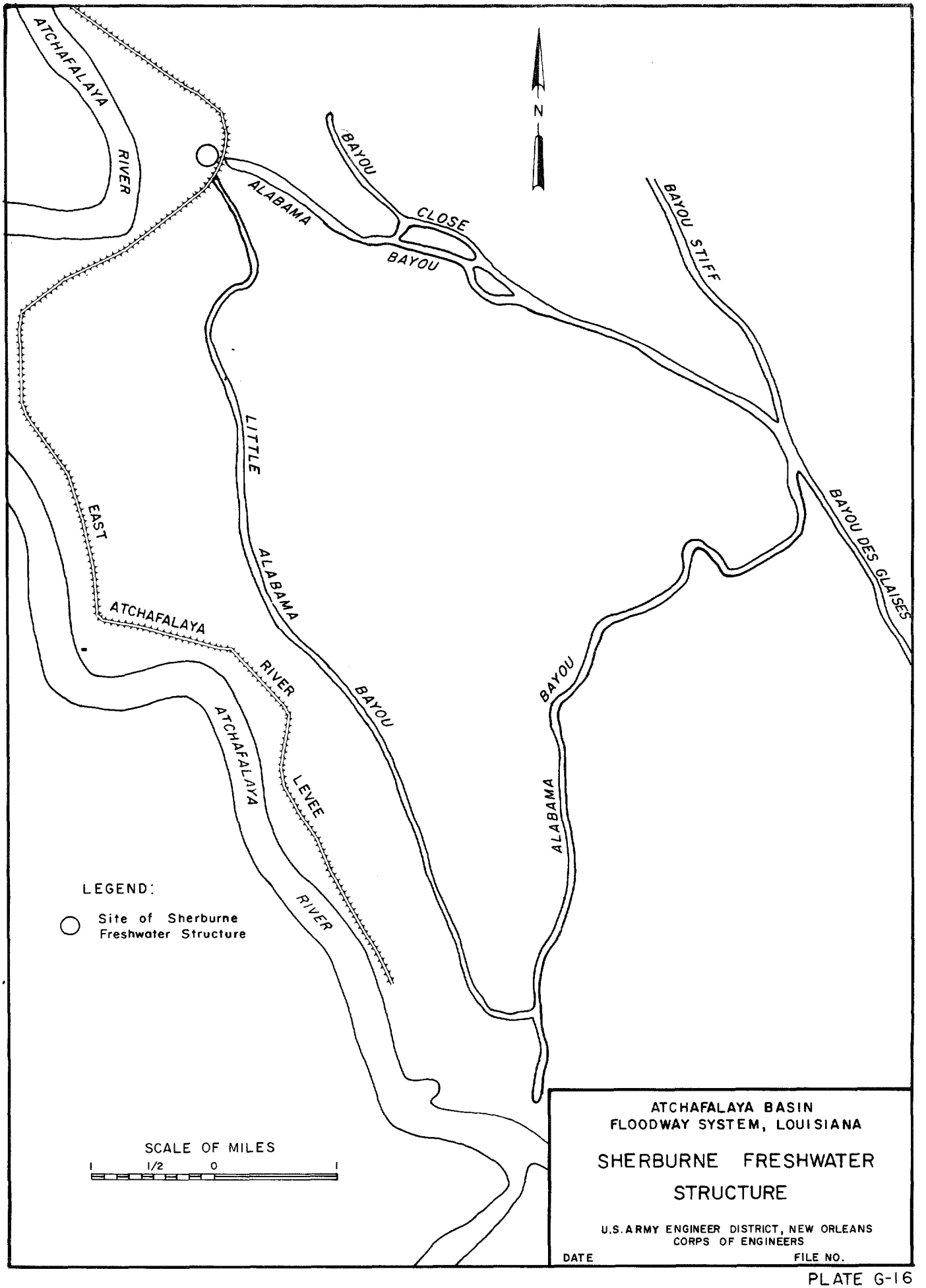
"COURTABLEAU" FRESHWATER STRUCTURE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE G-15



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SHERBURNE FRESHWATER STRUCTURE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE G-16

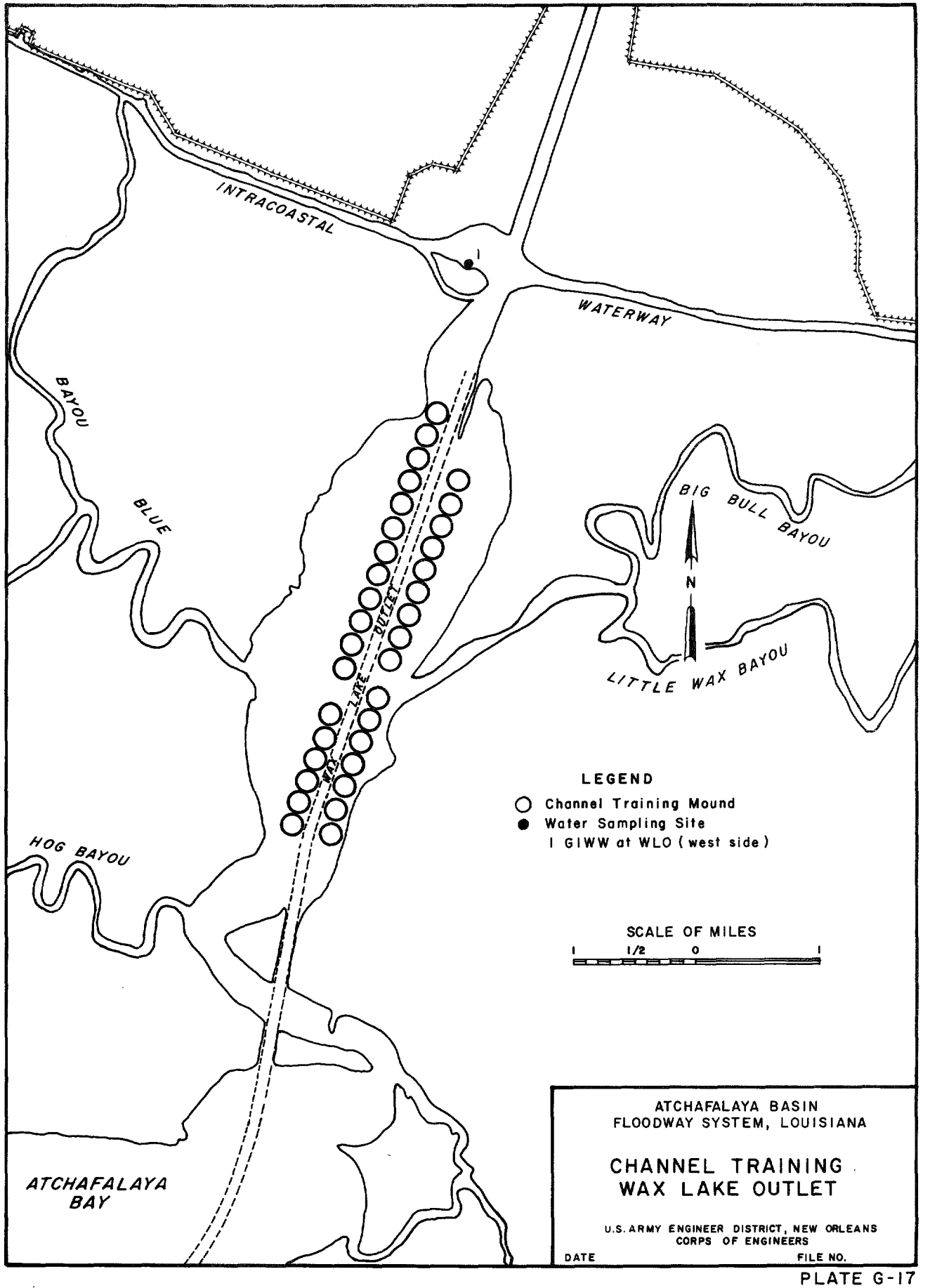
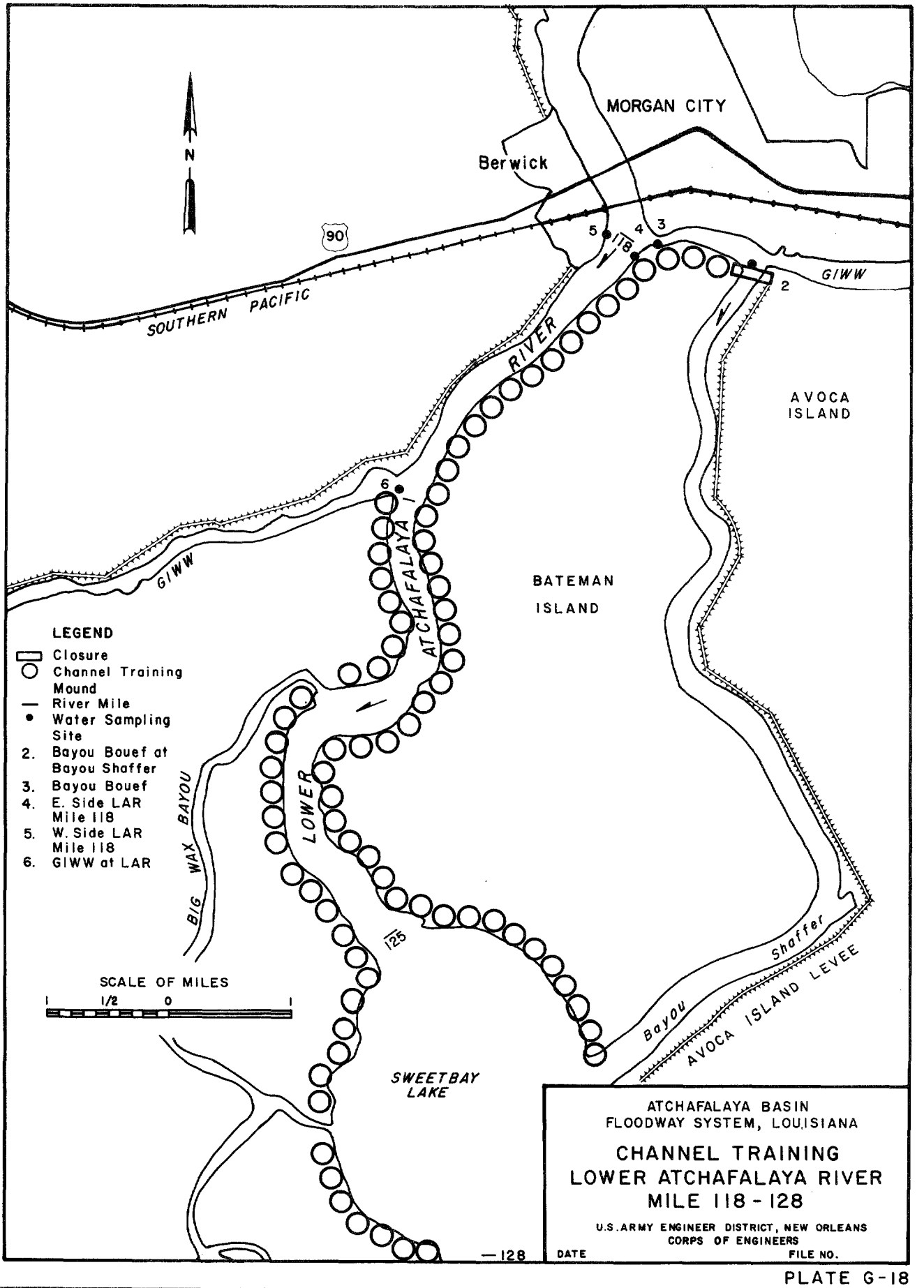

INTRACOASTAL
WATERWAY
BAYOU
BLUE
BIG BULL BAYOU
N
LITTLE WAX BAYOU
WAX LAKE OUTLET
HOG BAYOU
ATCHAFALAYA
BAY
LEGEND
Channel Training Mound
Water Sampling Site
1 GIWW at WLO (west side)
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
CHANNEL TRAINING
WAX LAKE OUTLET
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-17



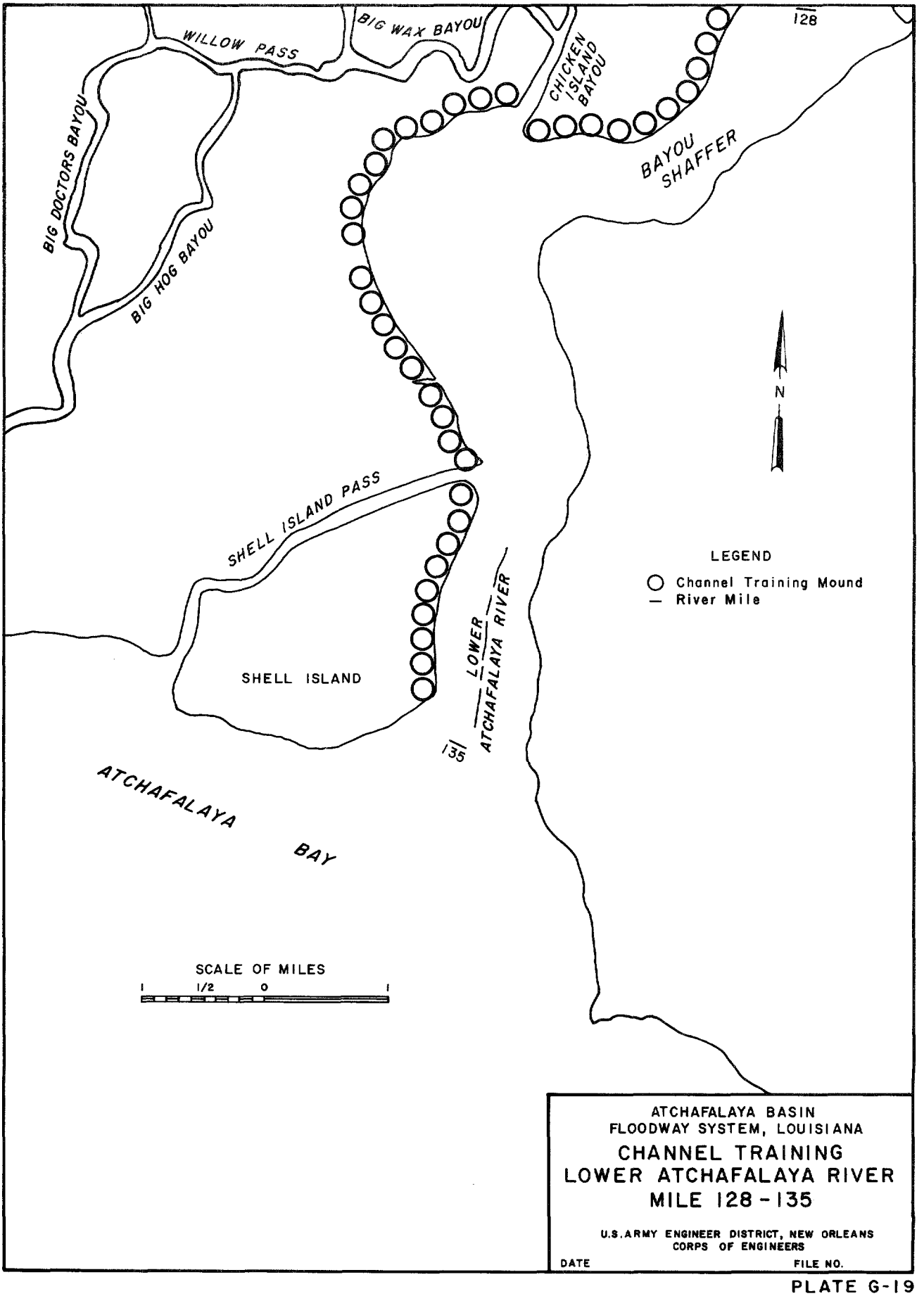
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

CHANNEL TRAINING
LOWER ATCHAFALAYA RIVER
MILE 118 - 128

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-18



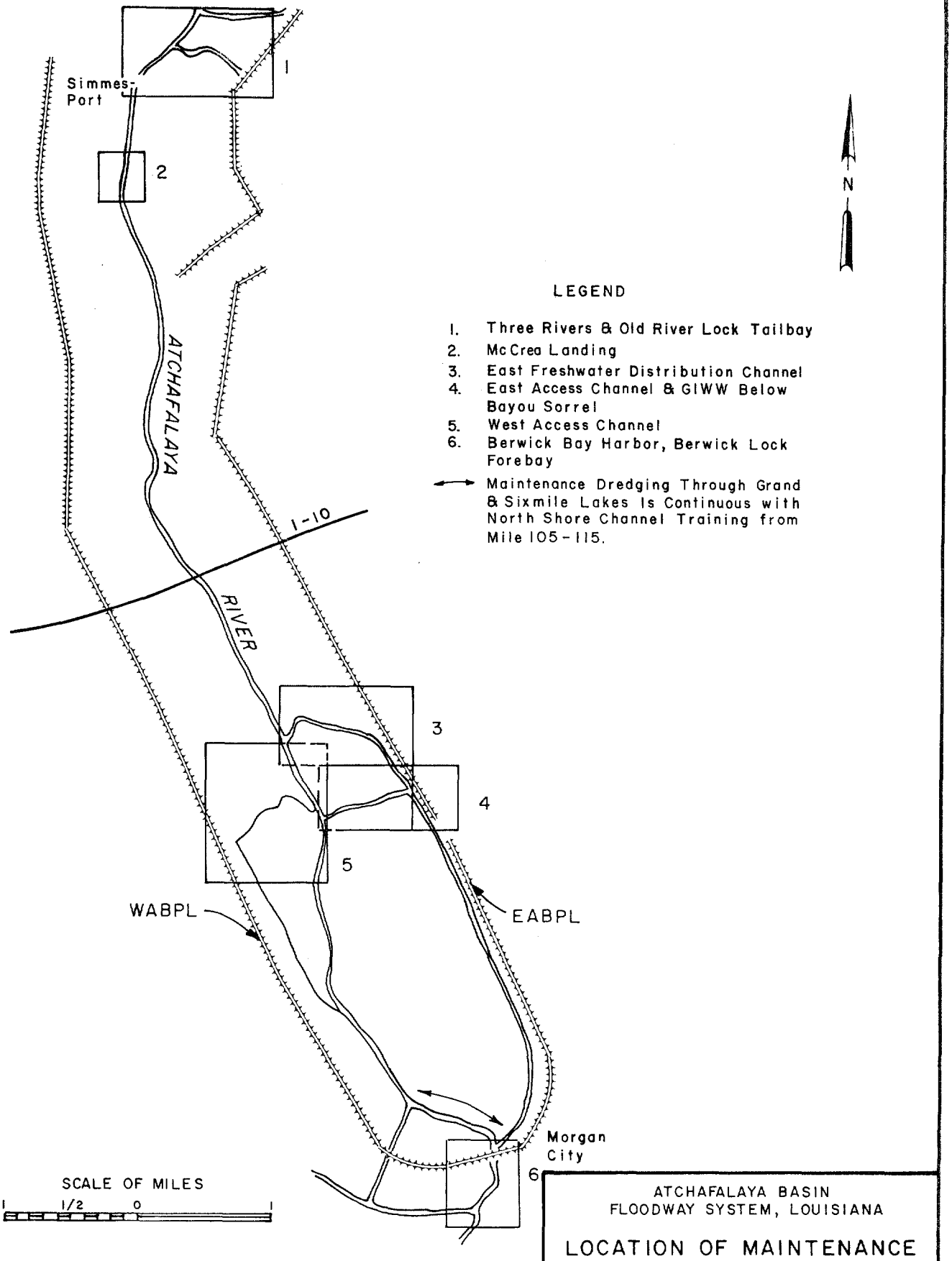
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

CHANNEL TRAINING
LOWER ATCHAFALAYA RIVER
MILE 128 - 135

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-19



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

LOCATION OF MAINTENANCE DREDGING SITES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-20

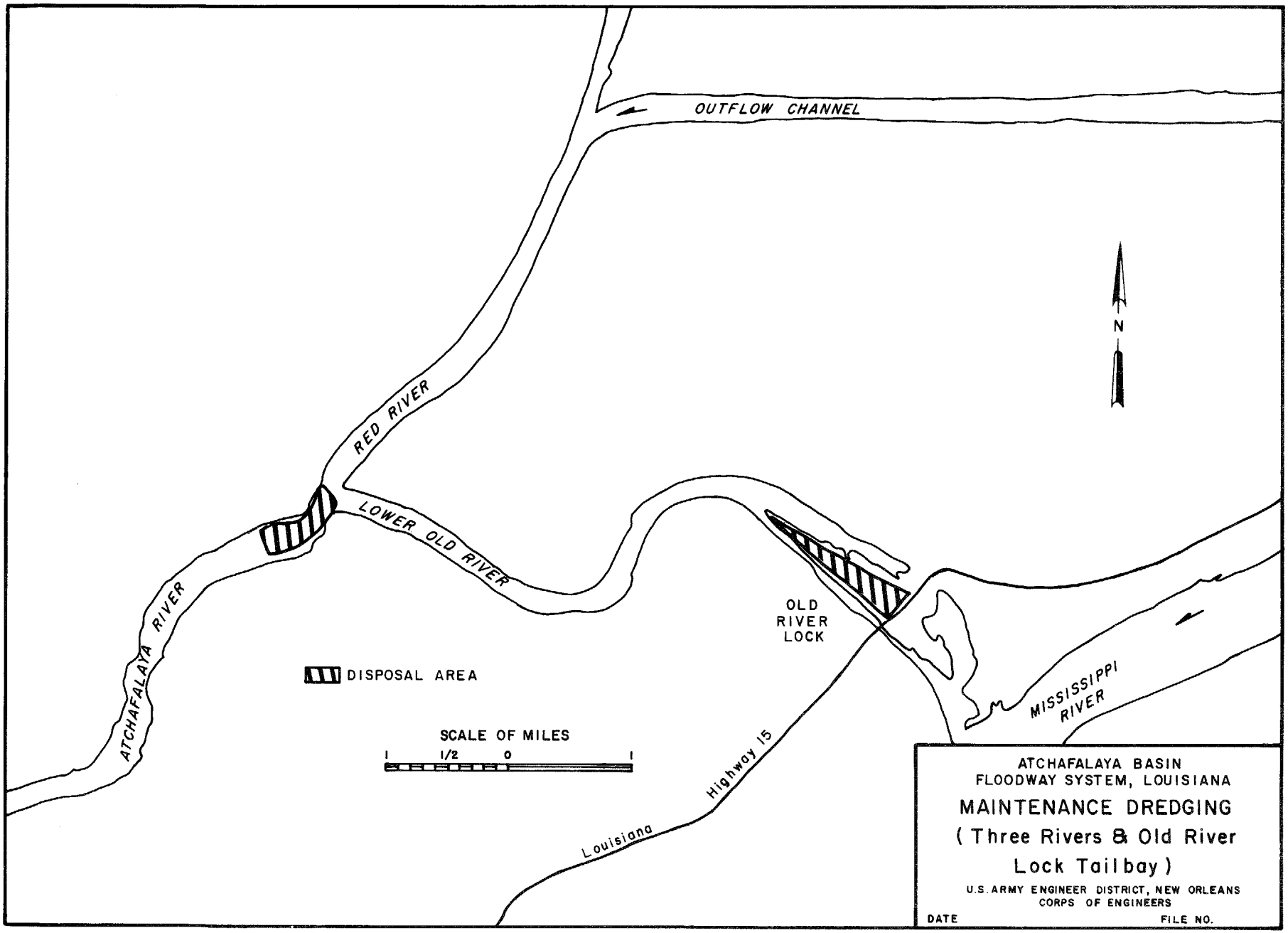

OUTFLOW CHANNEL
RED RIVER
LOWER OLD RIVER
ATCHAFALAYA RIVER
OLD
RIVER
LOCK
MISSISSIPPI
RIVER
N
DISPOSAL AREA
SCALE OF MILES
1 1/2 0 1
Louisiana
Highway 15
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAINTENANCE DREDGING
(Three Rivers & Old River
Lock Tailbay)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-21

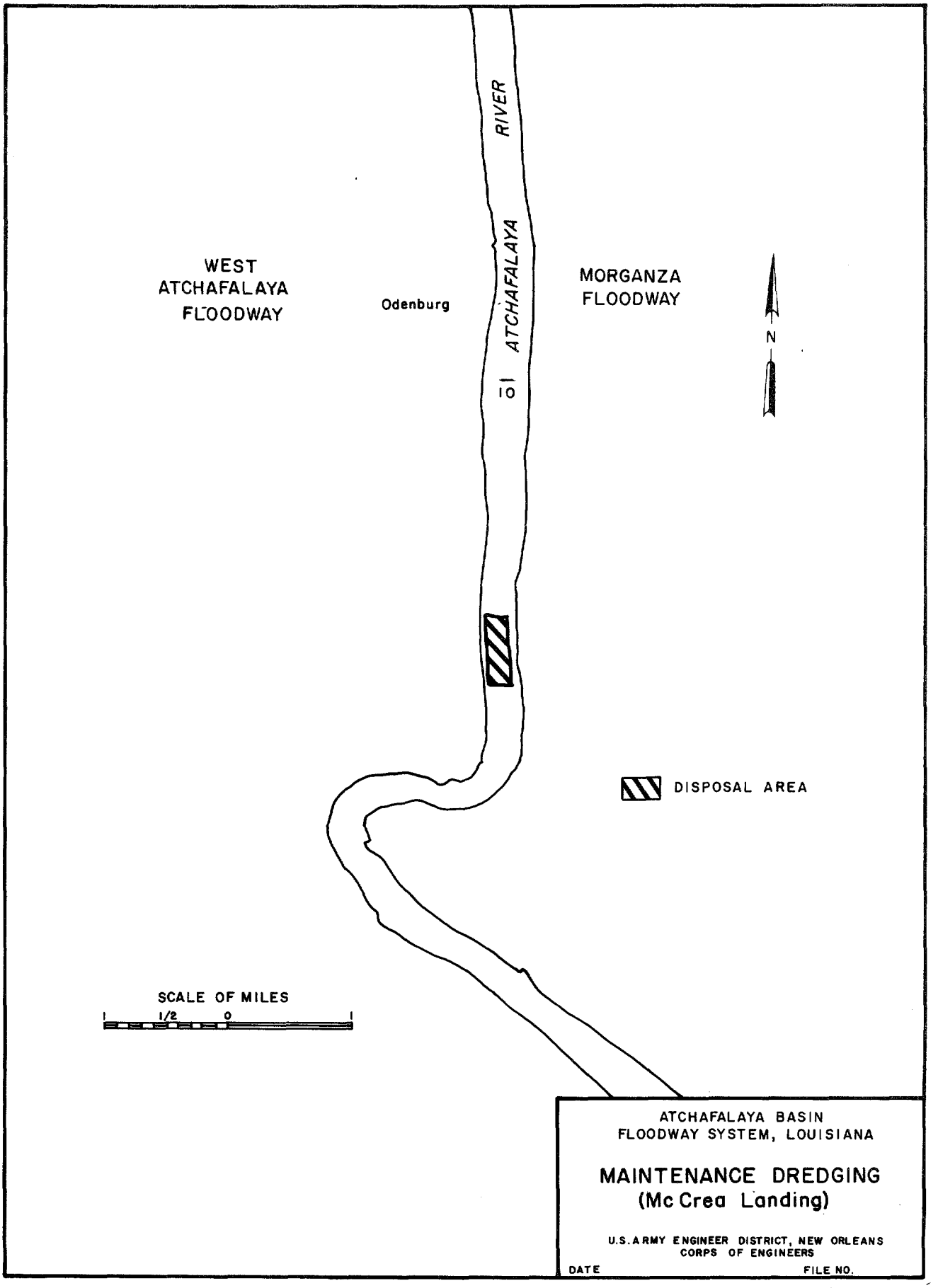
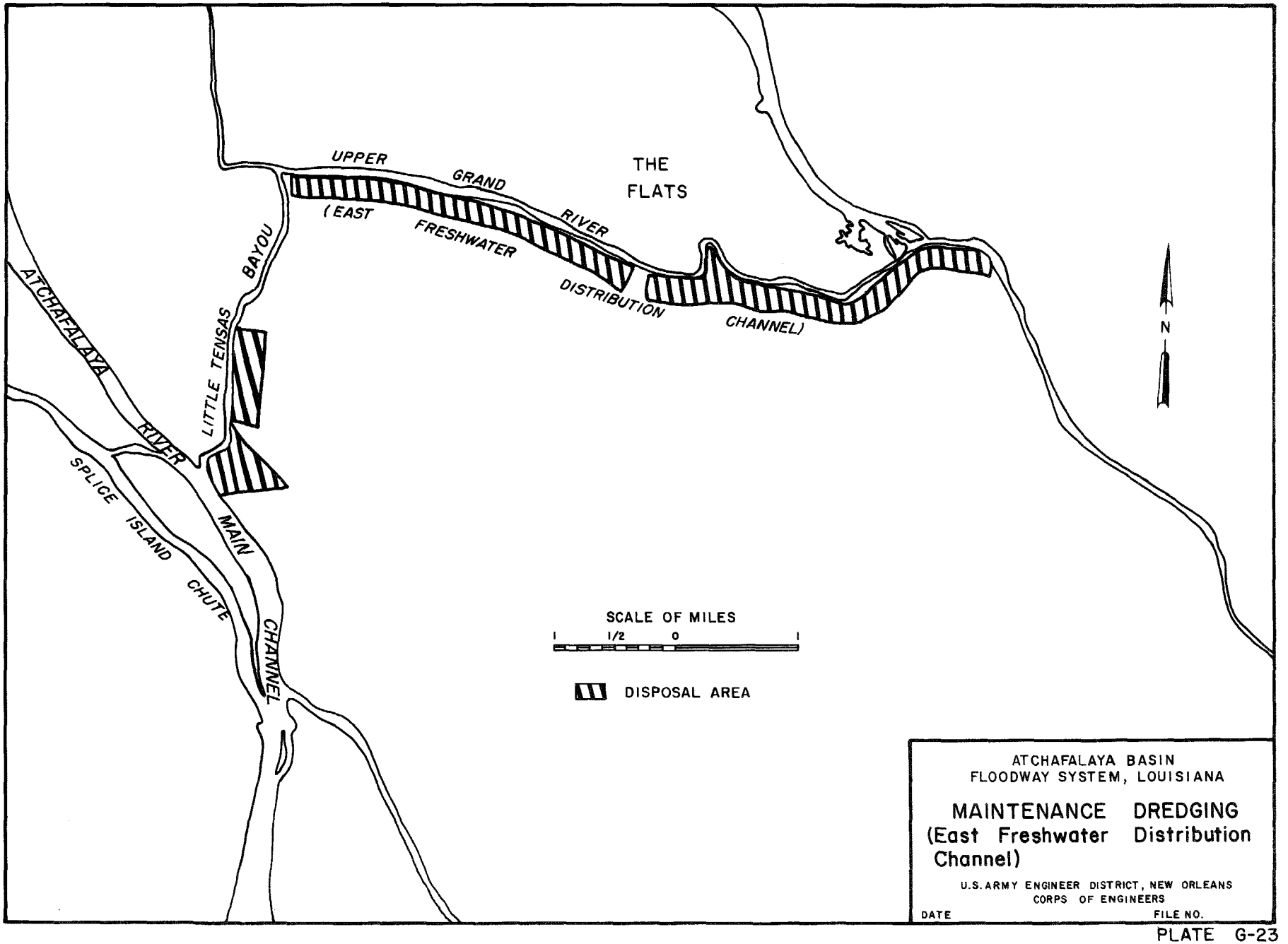

WEST
ATCHAFALAYA
FLOODWAY
Odenburg
ATCHAFALAYA RIVER
101
MORGANZA
FLOODWAY
N
DISPOSAL AREA
SCALE OF MILES
1/2
0
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAINTENANCE DREDGING
(Mc Crea Landing)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-22



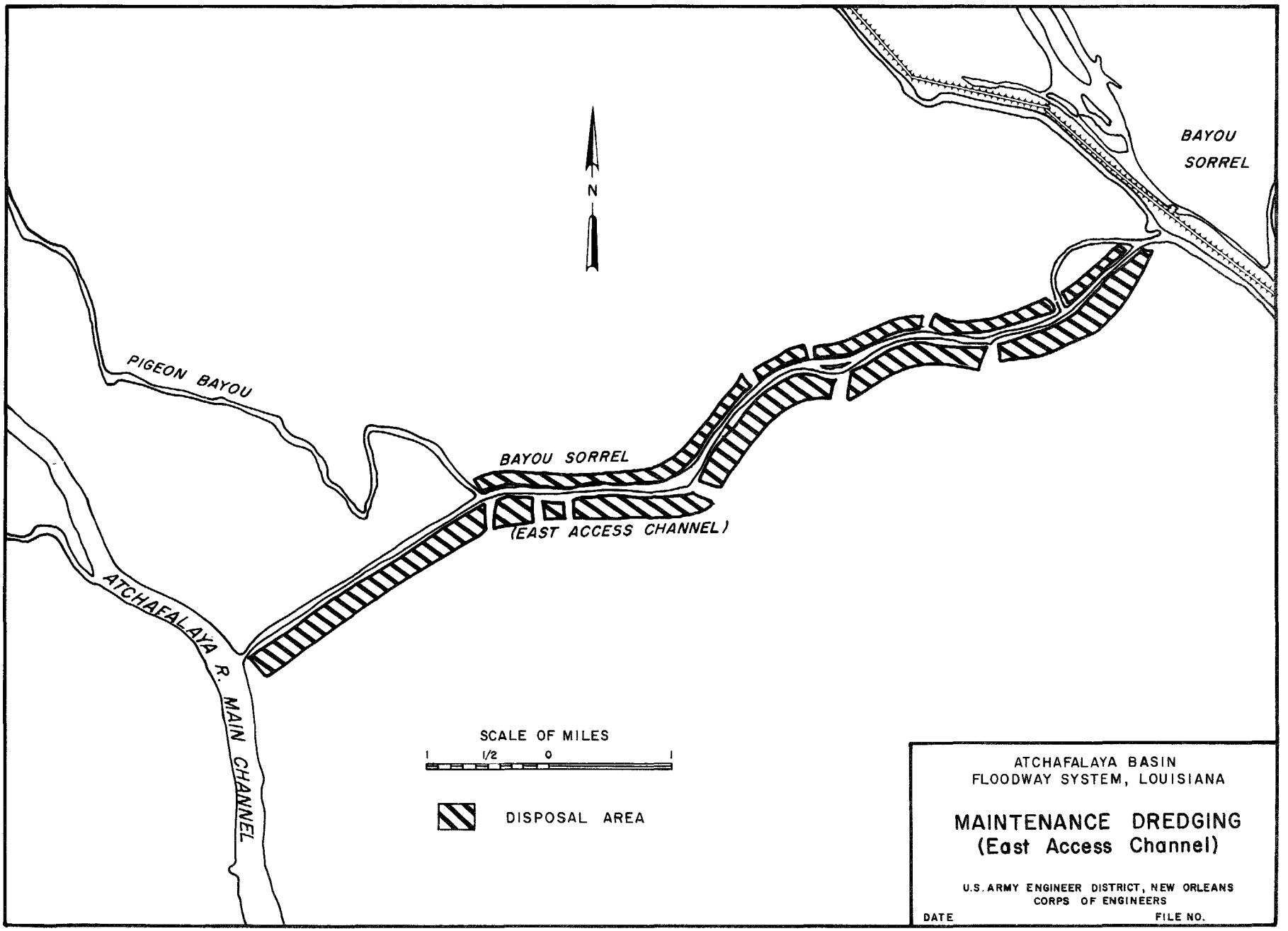
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MAINTENANCE DREDGING (East Freshwater Distribution Channel)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-23



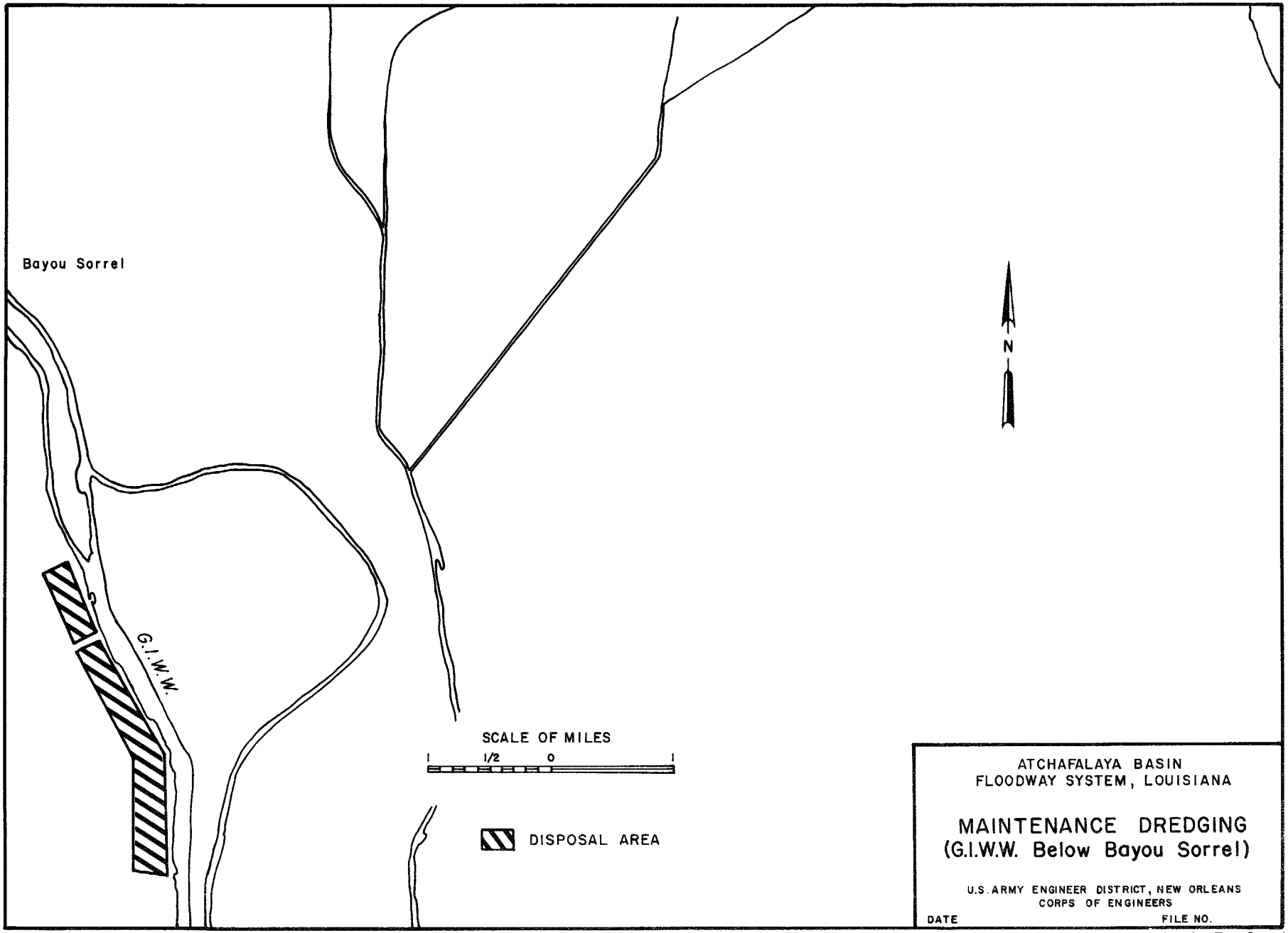
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MAINTENANCE DREDGING
(East Access Channel)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-24



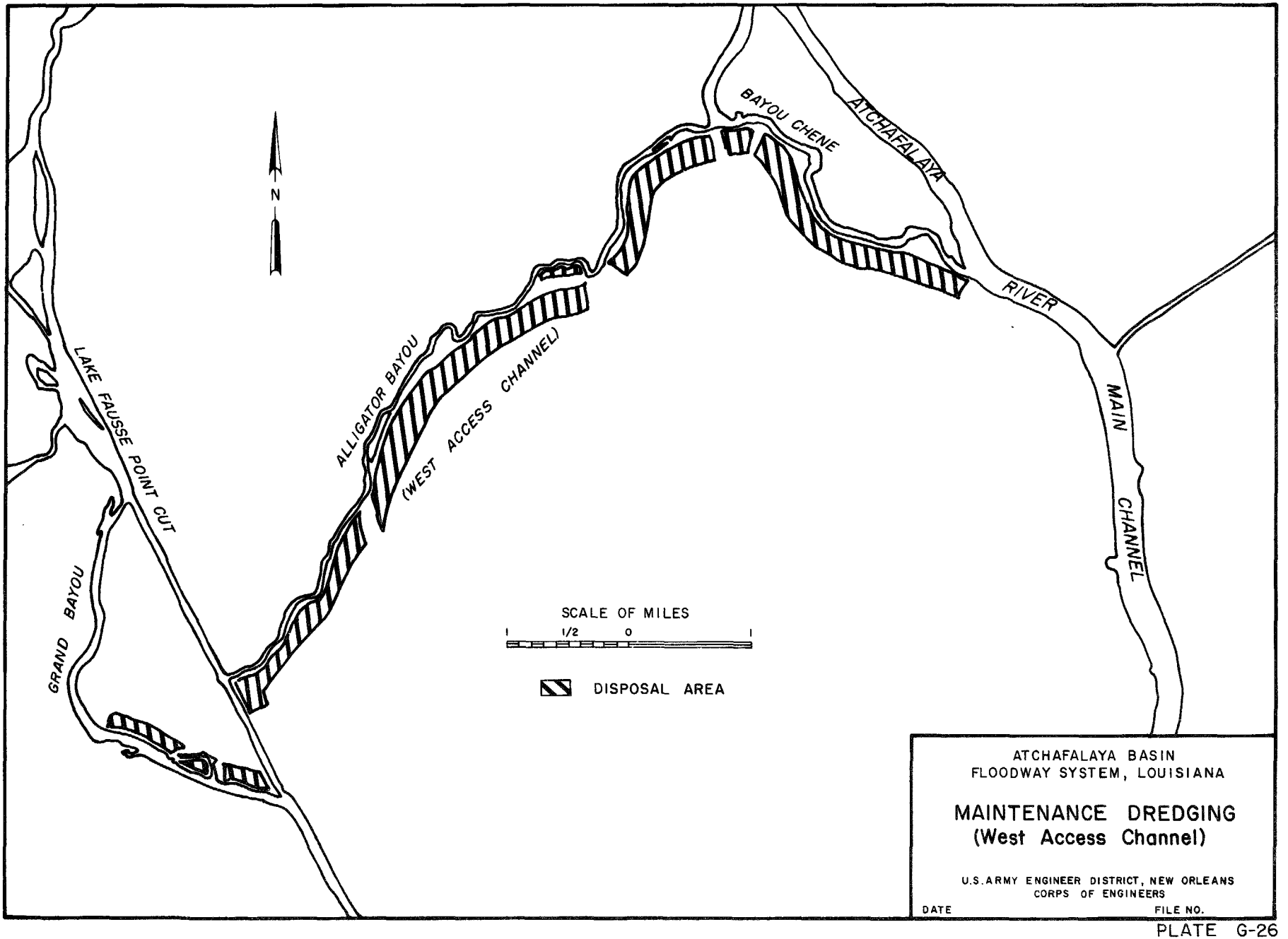
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MAINTENANCE DREDGING
(G.I.W.W. Below Bayou Sorrel)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-25



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MAINTENANCE DREDGING
(West Access Channel)

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE G-26

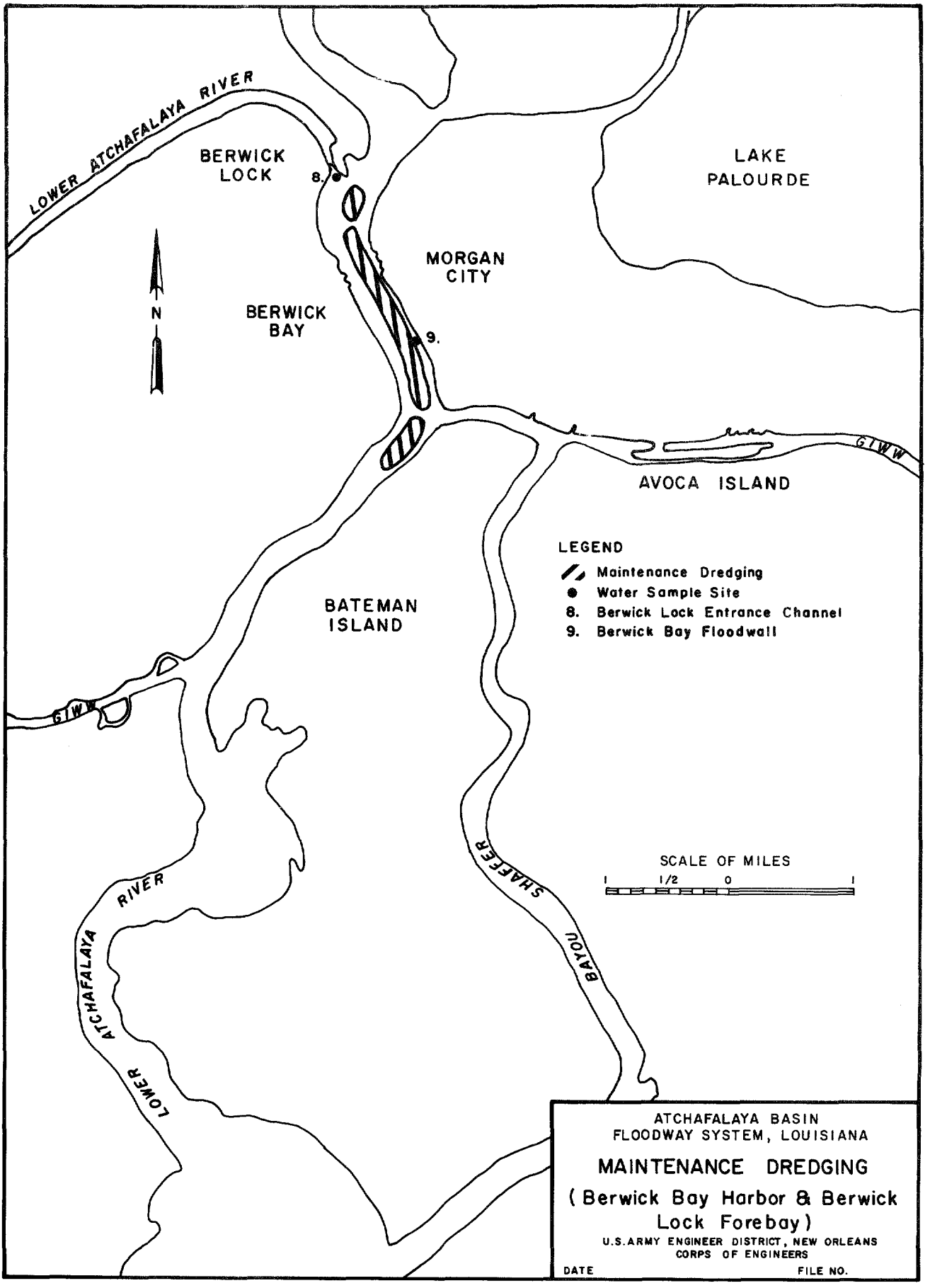

LOWER ATCHAFALAYA RIVER
BERWICK LOCK
8.
LAKE PALOURDE
MORGAN CITY
N
BERWICK BAY
9.
GIWW
AVOCA ISLAND
LEGEND
Maintenance Dredging
Water Sample Site
8. Berwick Lock Entrance Channel
9. Berwick Bay Floodwall
BATEMAN ISLAND
GIWW
SHAFFER BAYOU
LOWER ATCHAFALAYA RIVER
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAINTENANCE DREDGING
(Berwick Bay Harbor & Berwick Lock Forebay)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE G-27

APPENDIX H

ENDANGERED SPECIES ASSESSMENT

REVISED BIOLOGICAL ASSESSMENT OF ENDANGERED AND THREATENED SPECIES FOR THE ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA PROJECT

I. Introduction

This assessment was prepared for the US Fish and Wildlife Service (USFWS) and the US National Marine Fisheries Service (NMFS) to fulfill requirements of the US Army Corps of Engineers, New Orleans District (COE), in adhering to Section 7 of the Endangered Species Act Amendments of 1978. The COE, with input from the USFWS and the NMFS (see attached letters dated 11 February 1980 and 16 March 1981), prepared a list of endangered and threatened species that could occur within the project area and that could possibly be affected by the proposed project (Table 1). Possible project impacts upon each of these species were determined and are discussed in subsequent parts of this report along with pertinent information regarding the project setting, features of the recommended plan, methods used in determining impacts, and other relevant information.

TABLE 1
ENDANGERED AND THREATENED SPECIES THAT COULD BE AFFECTED BY THE PROPOSED ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA PROJECT

Endangered Species

1. Leatherback Sea Turtle (Dermochelys coriacea)
2. Kemps' Ridley Sea Turtle (Lepidochelys kempii)
3. Ivory-billed Woodpecker (Campephilus principalis)
4. Arctic Peregrine Falcon (Falco peregrinus tundrius)
5. Bald Eagle (Haliaeetus leucocephalus)
6. Eskimo Curlew (Numenius borealis)
7. Brown Pelican (Pelecanus occidentalis)
8. Bachman's Warbler (Vermivora bachmanii)
9. Red-cockaded Woodpecker (Picoides borealis)
10. Florida Panther (Felis concolor coryi)
11. West Indian Manatee (Trichechus manatus)
12. Sei Whale (Balaenoptera borealis)
13. Fin Whale (Balaenoptera physalus)
14. Sperm Whale (Physeter catodon)

Threatened Species

1. Loggerhead Sea Turtle (Caretta caretta)
2. Green Sea Turtle (Chelonia mydas)

II. Project Setting

The overall project area, which consists of the Red River backwater area, the Atchafalaya Basin Floodway system, and the backwater area northeast of Morgan City, is a vast lowland region confined by major meander belts of the Lower Mississippi and Red Rivers (Figure 1). The Atchafalaya River formed along the axis of this area about 500 years ago and today exists as the major distributary of the Mississippi River. The Atchafalaya Basin system conveys about 30 percent of the combined flows of the Red and Mississippi Rivers southward to the Gulf of Mexico through a system consisting of the Old River control structure, the river proper, and many interconnected channels, swamps, lakes, and marshes. The Atchafalaya River is bounded on the east and west by artificial levees, built in the 1930's and located at an average distance of about 7 miles from the main river channel. Within this area, impacts due to the proposed implementation of the recommended plan would occur primarily in the area south of US Highway 190. Within this project affected area (Figure 2), the predominant habitat types are bottomland hardwood forest, cypress-tupelo swamp, marshland, and cultivated farmland. Much of the project affected area is subject to occasional overbank flooding from the Atchafalaya River. In the leveed floodway portion south of Interstate Highway 10, overbank flooding is usually an annual event. Ths project affected area serves as highly valuable habitat for a variety of fish and wildlife species, as well as being one of the largest and most important semi-natural areas remaining in the United States. This area is heavily used for commercial fishing and for fish-and-wildlife-oriented recreational purposes. The human population of the project affected area is primarily rural and highly dependent upon the natural resources of soil, minerals, timber, fish, and wildlife for livelihood. A large part of this population is descended from French-speaking Acadian exiles who began coming to Louisiana in the 1770's. North of Interstate Highway 10 and along the Mississippi and Lafourche Ridges, farming activities are highly important. Considerable acreage here is devoted to the growth of soybeans. South of Interstate Highway 10, agriculture is less important, and the economy is based on commercial fishing and trapping, outdoor recreation, and the extraction of oil and gas.

III. Recommended Plan

The recommended plan was developed to meet the basic criterion of safely carrying the Mississippi River and Tributaries project flood to the Gulf of Mexico. In addition, it offers a balance with respect to contributions to national economic development and environmental quality. The basic features of this plan are illustrated in Figure 3 and are discussed in the following paragraphs by groups.

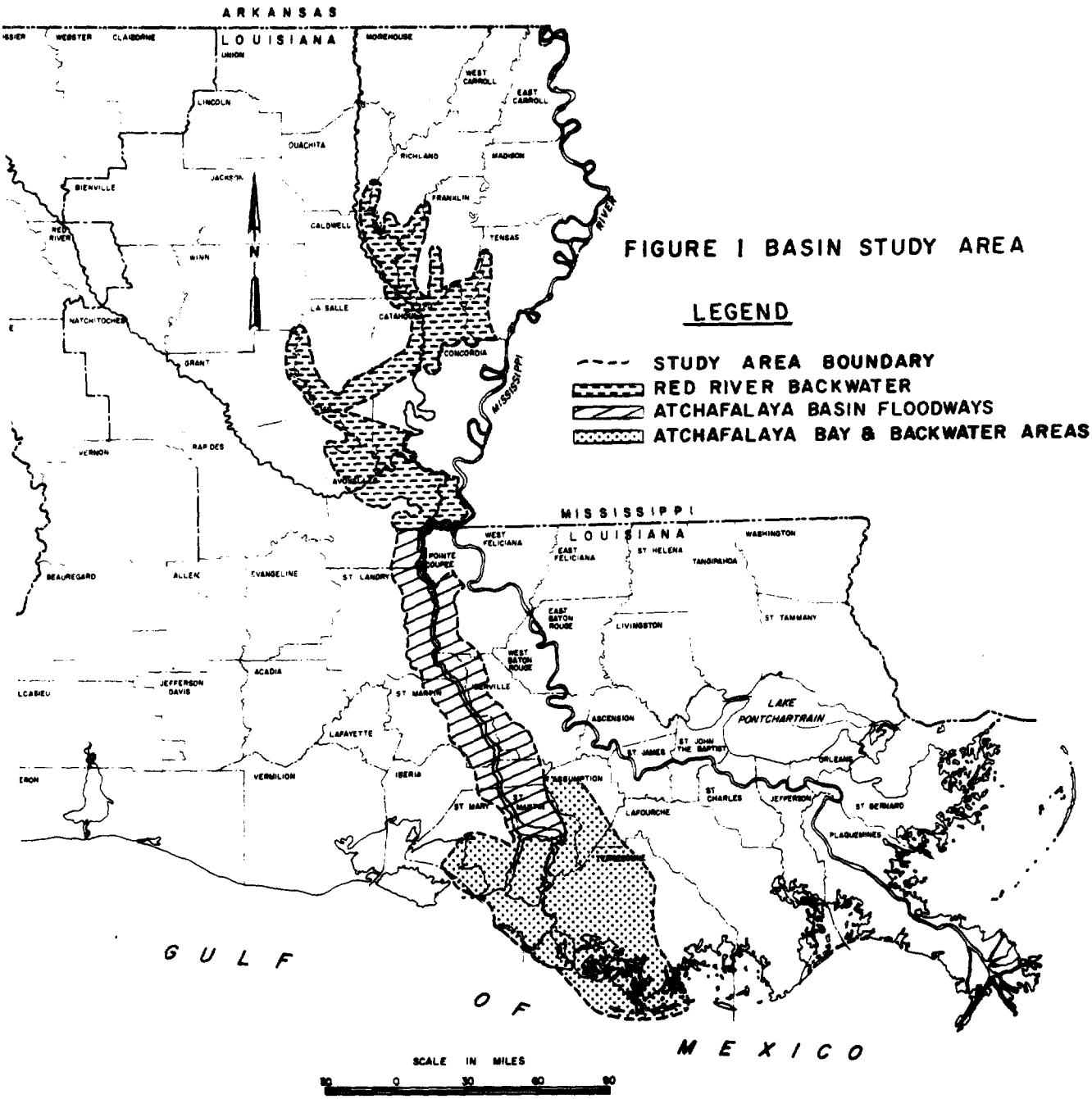


FIGURE I BASIN STUDY AREA

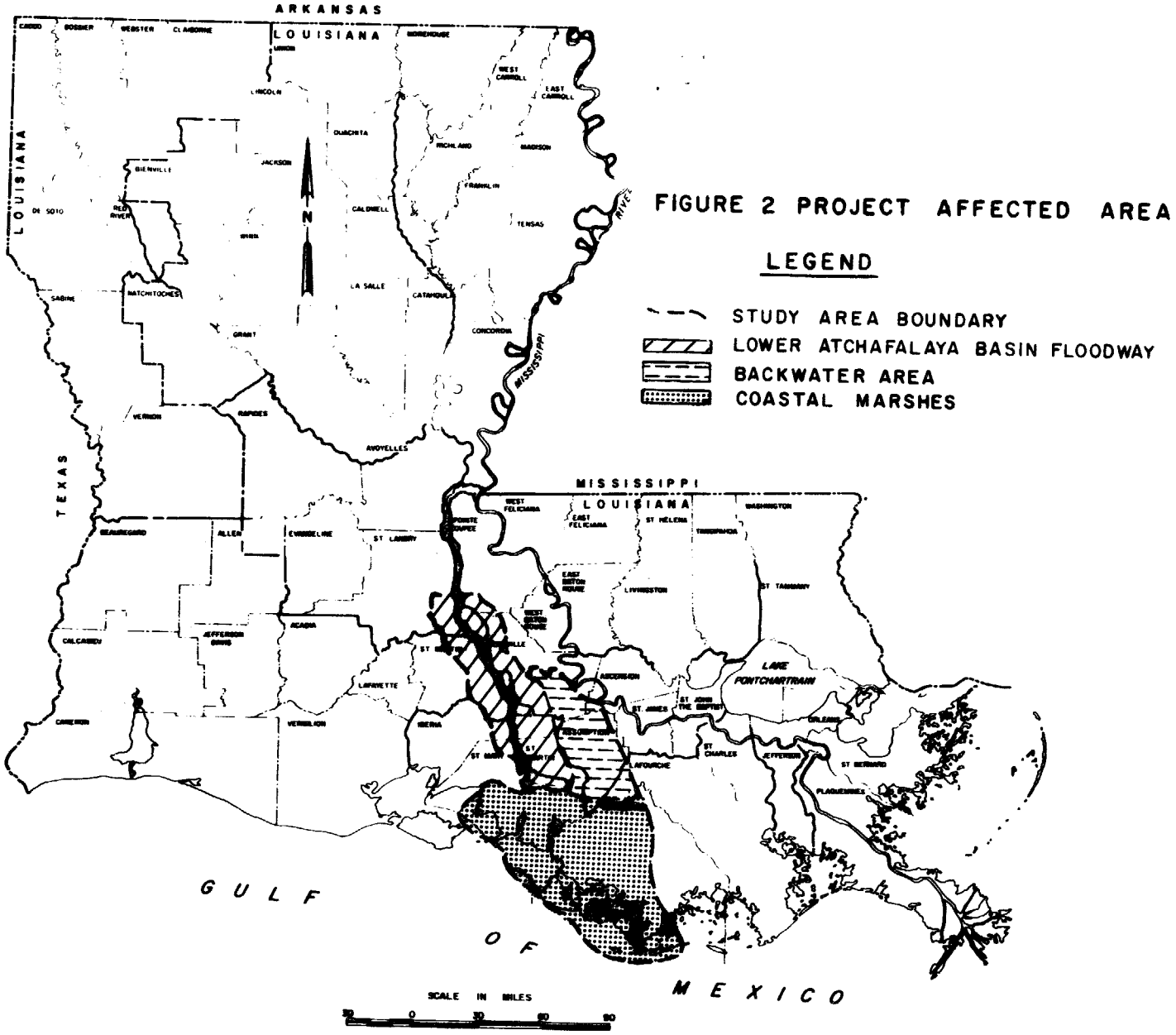


FIGURE 2 PROJECT AFFECTED AREA

LEGEND

- STUDY AREA BOUNDARY
- LOWER ATCHAFALAYA BASIN FLOODWAY
- BACKWATER AREA
- COASTAL MARSHES

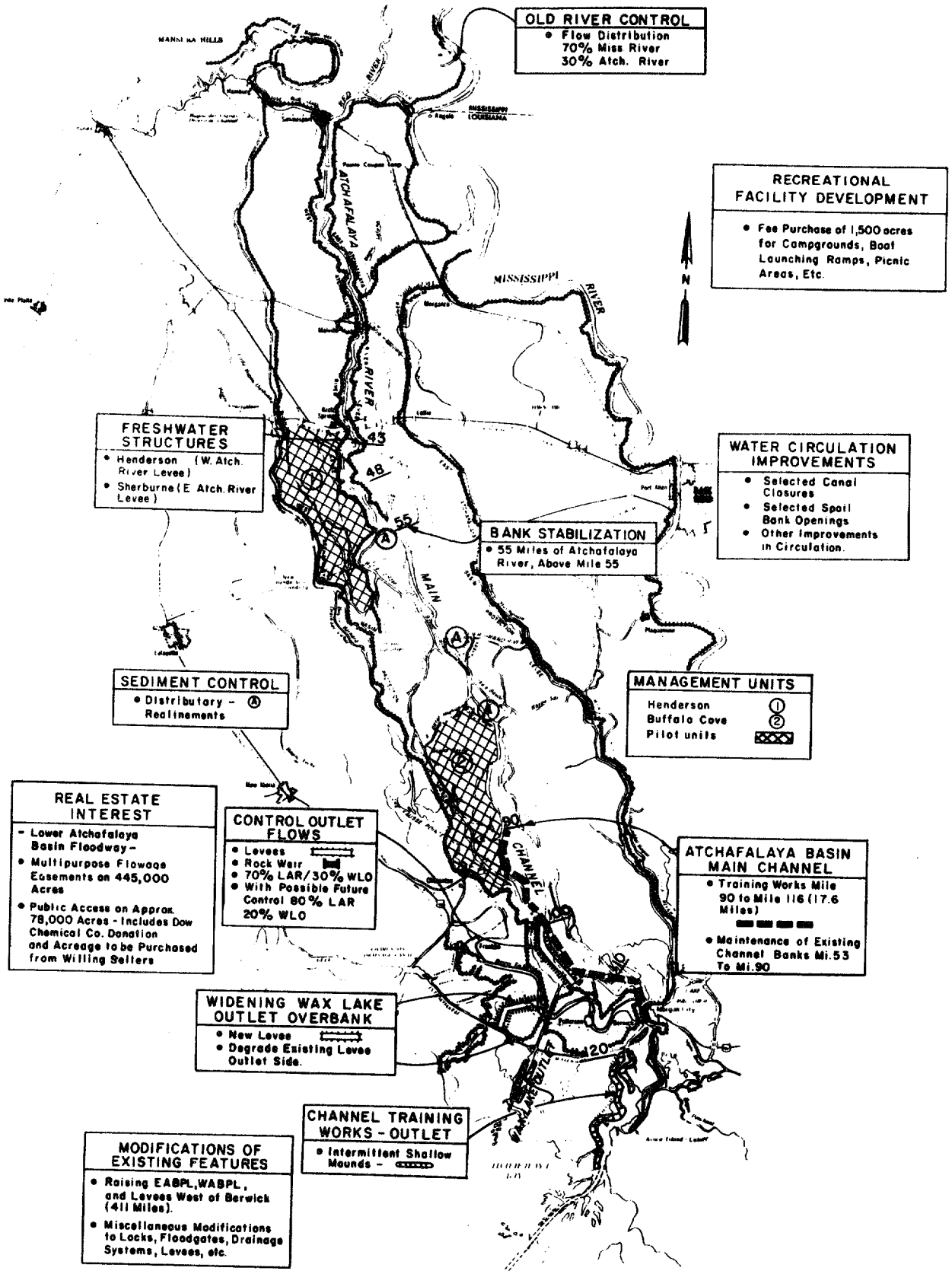


FIGURE 3 MAJOR FEATURES OF RECOMMENDED PLAN

GROUP I - ALTERNATIVES FOR OPERATION OF THE OLD RIVER CONTROL STRUCTURE

Maintain 70/30 Percent Distribution of Total Flows between the Mississippi and Atchafalaya Rivers below Old River, Respectively.

This is the present distribution and it would continue to be maintained on a daily basis.

GROUP II - ATCHAFALAYA RIVER MAIN CHANNEL DEVELOPMENT AND LEVEE RAISING ALTERNATIVES

Raising of the East and West Atchafalaya Basin Protection Levees, Atchafalaya River Levees, and Levees West of Berwick.

Levee raising has been an ongoing process since 1972. These levees would need to be raised approximately 6 feet in the southern portions and approximately 4 feet in northern portions. Once raised, the capacity of the lower floodway to safely pass the project flood would be assured.

Channel Training Alternative.

Reduction of sediment deposition in overbank areas would be accomplished by dredging 29,000,000 cubic yards (cy) of material from the river and depositing it on the banks to confine flows and sediment. These new banks would initially cover approximately 6,000 acres from river mile 90 to mile 116. Low back levees would prevent runoff of sediment into adjacent areas. There would be no gaps in the banks and they would be built to a height that would be overtopped during 50 percent of the years of project life. Future bank maintenance from mile 53 to mile 90 could become necessary if severe bank erosion occurred in this reach and repairs were needed to confine the river.

Bank Stabilization.

The banks of the Atchafalaya River would be stabilized where necessary by placement of rip-rap or articulated concrete mattresses from Simmesport to the head of Whiskey Bay Pilot Channel, a distance of 55 miles.

Minor Project Features.

This would include construction and maintenance of locks, culverts, and pumping stations. Maintenance dredging of freshwater and access channels would also be included.

GROUP III - SEDIMENT CONTROL ALTERNATIVES

Distributary Channel Realinements.

The major distributary channels of the Atchafalaya Basin main channel (Old Atchafalaya River, east and west access and east freshwater distribution channels) would be realined to reduce the entrance angle to between 30 to 45 degrees to reduce the volume of sediments being carried by these channels into overbank and open water areas. This would be accomplished by blocking the distributary near the main channel, while at the same time dredging a new entrance channel.

GROUP IV - MANAGEMENT UNITS AND RELATED FEATURES

Phased Implementation.

This feature would provide for the initial implementation of two management units, Buffalo Cove and Henderson, and based on detailed studies of the results of their operation, the development of others. Development of management units would require restriction of their natural outlets by constructing weirs and, in some cases, low level levees. Construction of new inlets at the upper end of each management unit would probably be necessary, as well as the closure of certain bayous and canals, and the improvement of circulation within the units. Rollovers for small boat access would be installed at some bayou and canal closures.

Freshwater Structures.

A freshwater diversion structure near river mile 48 would serve as an inlet for the Henderson management unit area. This structure would be a gated culvert designed to pass a maximum of 3,000 cubic feet per second (cfs) into Big Bayou Graw or a similar site nearby.

The Sherburne Freshwater Diversion Structure at river mile 43 would provide freshwater to the Alabama Bayou area. This gated culvert would pass a maximum of 3,000 cfs into Big Alabama Bayou.

GROUP V - ALTERNATIVE FLOODWAY LAND-USE PLANS

Real Estate Interest.

The recommended real estate features of the plan provide for those interests needed to serve three basic functions: flood control, environmental protection, and public access.

Flood Control.

The Flood Control Act of 1936 authorized the US Army Corps of Engineers to acquire certain flowage rights in the Lower Atchafalaya Basin. The Act further specified: "That no flowage easements shall be paid for by the United States over properties subject to frequent overflow in the Atchafalaya Basin below the approximate latitude of Krotz Springs." It was determined that about 68,000 acres in the Lower Atchafalaya Basin Floodway were subject to purchase of flowage easements under this Act. To date, those easements have been obtained on about 9,000 acres. The recommended plan proposes the purchase of flowage rights on the remaining 59,000 acres. In addition, the right to prohibit the construction of new permanently habitable structures and to prohibit or regulate contruction of other structures, including camps, would be acquired over all privately owned land (approximately 445,000 acres) in the lower basin except for the developed ridges. This right would assure the lower floodway's readiness for operation on short notice, preclude the need for Corps of Engineers emergency flood-fighting operations and associated Federal expenses within the basin, and insure no liability on the part of the Federal Government for the public health, safety and welfare by controlling industrial development that could prove hazardous to the public during floodway operations.

Environmental Protection.

Real estate interests proposed for protection of environmental values in the lower basin were developed in response to general study goals of the authorizing congressional resolutions and specific study objectives as defined by the Agency Management Group, i.e., to "retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands." In addition to those rights needed for flood control, the recommended plan proposes other rights specifically for environmental protection. These rights are considered necessary for preservation of fish and wildlife habitat and maintaining the "wet and wild" environmental appeal of the lower floodway. Such rights would include control over all excavation and landfill operations and allowance for extension of the time and duration of flooding by natural or artificial means. These rights would prevent or delay potential degradation of existing flowage patterns, prevent destruction of habitat and provide for water level control under the proposed management unit concept. Additional environmental rights would prohibit the conversion of land to other uses and would provide control over the method of cutting timber. The proposed land conversion control is directed at preventing destruction of fish and wildlife habitat, i.e., clearing of forests for the purpose of agricultural production of soybeans or other higher value economic pursuits, such as residential or industrial development. Control over timber would also be aimed at preserving habitat as well as

maintaining the lower basin's environmental appeal by controlling clearcutting and promoting sustained yield forestry practices. A comprehensive multipurpose easement, or higher interest if mutually agreed upon, containing the cited environmental interests would be acquired over the entire 445,000 acres of privately owned land in the lower basin, except for the developed ridges.

Public Access.

The public access function was subdivided into two basic categories that relate to separate features of the proposed plan. The first, recreation development, was formulated in response to the study authorizing resolutions. The second, general public access, was developed in response to the Agency Management Group defined objective to "maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway" and is based on recommendations of the Governor of the State of Louisiana.

For the recreational development feature, a total of 1,500 acres would be acquired in fee title in the proximity of the lower floodway to provide for the development of campsites, boat-launching ramps and other facilities complementary to outdoor recreational activities. Included would be a limited number of day-use or picnicking sites and 200 to 500 acres set aside for special and unique areas, such as rookeries.

The general public access feature would be accomplished by the following described state managed lands. At least 30,000 acres has been made available in the Lower Atchafalaya Basin Floodway through a donation to the state by the Dow Chemical Company of land in and around the floodway in excess of 40,000 acres. Additionally, at least 48,000 acres in the floodway would be made available by fee title acquisition from landowners identified as willing sellers. These proposed lands are associated with the environmental goal of maintaining or enhancing productivity of the habitat, i.e., allowing the management of timber for fish and wildlife habitat improvement, as well as preserving existing esthetic values to benefit the pubic access user.

For all new real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

GROUP VI - ALTERNATIVES FOR FLOODWAY OUTLETS AND DELTA BUILDING

Reestablish Approved Design Flow Distribution (Lower Atchafalaya River 80 Percent/Wax Lake Outlet 20 Percent).

Initially, present flows (70/30) would be maintained by a weir and low-level levee upstream of Wax Lake Outlet. If the ecosystem responded favorably, flows into Wax Lake Outlet would be further restricted in the future by modification of the weir for limiting the low to normal flows to 20 percent.

Widen Wax Lake Outlet Overbank.

A new levee would be built west of the existing levee along the west side of Wax Lake Outlet to form a new overbank outlet. Existing levees within the widened overbank area would be degraded to ground level.

Training Works below Morgan City.

This feature would provide for training works below Morgan City on both the Wax Lake Outlet and the Lower Atchafalaya River and a closure of Bayou Shaffer. Construction of the training works would require the dredging of approximately 16 miles of existing channel bottom areas and placing the dredged material in adjacent shallow water bottoms or on adjacent stream banks, leaving gaps between disposal areas to allow for continued development of the overbank marshes, for navigation access, and for pipelines.

GROUP VII - ALTERNATIVES TO REDUCE BACKWATER FLOOD DAMAGES EAST OF THE FLOODWAY

Delayed Action.

A decision on a solution to the backwater flooding problem would be temporarily delayed until completion of additional studies which would be designed to fully evaluate the impact of suggested solutions such as extension of the Avoca Island levee, ring levees, or some yet to be developed new alternative. In the interim, some relief from backwater flooding problems would be brought about by other plan features.

GROUP VIII - MANAGEMENT ENTITY

The District Engineer would be the sole jurisdictional authority to protect and oversee Federal interests in the Atchafalaya Basin Floodway System upon implementation of the proposed comprehensive multi-purpose plan. Recreational and environmental features of the plan would be operated and maintained by the appropriate Louisiana State agencies under license and lease agreements administered by the US Army Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on special studies and

collateral interests as required by Federal law and Corps of Engineers' regulations.

GROUP IX - MITIGATION MEASURES

No mitigation measures would be necessary.

IV. Study Methods

This assessment was completed following a two-year period of intensive study of the project area, which included numerous on-site visits, conversations with knowledgeable biologists, and a review of the available literature. No major difficulties were encountered in obtaining data; however, the vastness of the project area made it impossible to conduct a comprehensive survey to determine if all the listed species do, in fact, occur within the area.

V. Impact Assessment

Leatherback Sea Turtles.

The leatherback sea turtle is distributed throughout the tropical seas of the world and travels the farthest north of all sea turtles. This species is a powerful swimmer and is the most pelagic of the sea turtles and may be seen far out to sea.

Nesting, occurring from April to December in the United States, is confined to the coast of Florida. In 1962, one leatherback nest was discovered on Destin beach in northern Florida. Occurrences reported for the northern Gulf of Mexico include hatchlings sighted on the beaches in Walton and Okaloosa Counties, Florida, a report by Denver Wildlife Research Center personnel (National Fish and Wildlife Laboratory, 1981) that leatherbacks are seasonally abundant off Panama City, Florida; and two females netted by a fisherman off the southeastern coast of Louisiana in 1951.

It is unlikely that this sea turtle would occur in the project area. The leatherback appears to follow schools of its preferred food, the cabbage head jellyfish, Stomolophus meleagris. The low salinities of Atchafalaya Bay and adjacent bays might inhibit the occurrence of this jellyfish and, thereby limit the occurrence of leatherbacks in the project area.

Kemp's Ridley Sea Turtle.

Distribution of the Kemp's ridley sea turtle is limited to the Gulf of

Mexico. Adults nest from April to August during daylight hours on a single beach near Rancho Nuevo, Tamaulipas State, Mexico. Adults tagged on this beach have been subsequently recovered in the shrimp-rich areas of the Gulf and coastal waters of Louisiana and Campeche, Mexico. Some individuals of the populations may nest or try to nest elsewhere. In 1977, during an aerial survey, a small turtle was spotted on the sandy beaches of Timbalier Island, Louisiana. It may have been a female Kemp's ridley looking for a nesting site (National Fish and Wildlife Laboratory, 1981).

Nearshore gulf habitats are very important to this species. The Kemp's ridley is primarily a carnivore and a bottom-feeder. It prefers to eat crustaceans, and many of its recorded food items inhabit estuarine and inshore areas with silt substrates. Adults and subadults may feed in the highly productive white shrimp-portunid crab beds of Louisiana, from Marsh Island to the Mississippi Delta.

In addition to utilizing the shallow coastal areas for feeding, Kemp's ridley sea turtle may overwinter in a dormant state in the shallow waters of northern Florida and other estuarine systems within the Gulf. Although having not been reported in the project area (McGehee, personal communication), the Kemp's ridley is the most likely sea turtle to be found in Atchafalaya and East and West Cote Blanche Bays. This species has been seen along coastal localities of Vermilion and Terrebonne Parishes and in the Intracoastal Waterway in Cameron Parish (Keiser, 1976). Sea turtles are extremely tolerant of freshwater (McGehee, personal communication). Therefore, none of the salinity regimes, which could result from any changes through Wax Lake Outlet and the Atchafalaya River as predicted with the recommended plan, should adversely impact this species. It also appears that the predicted salinity regimes would not significantly affect shrimp production in the area. Thus, the shrimp beds in East and West Cote Blanche Bays would continue to be a possible food source for this sea turtle throughout the project life.

Loggerhead Sea Turtle.

The loggerhead sea turtles have a world-wide distribution in temperate and tropical waters. This sea turtle is a confirmed wanderer. It may be found in the warm waters of the continental shelf, in bays, lagoons, and estuaries. The former nesting range from North Carolina to Mexico is now restricted to North Carolina, Florida, and rarely, gulf coast islands. From April to August, a small portion of the population nests in the Gulf of Mexico. Most of this nesting has occurred in the Chandeleur Islands and the barrier islands of Mississippi and Alabama.

Loggerheads are primarily carnivorous. They forage for a variety of invertebrates and sea grasses in many habitats, including coral reefs, rocky places, an old boat wrecks.

The occurrence of this species in the project area is less likely than that of Kemp's ridley. However, loggerheads are reported to occur along coastal Louisiana from Southwest Pass to Marsh Island (Keiser, 1976). Its tolerance for a variety of salinities may allow this species to wander into Four League Bay, Atchafalaya Bay, East and West Cote Blanche Bays, and Vermilion Bay in search of food. The outflow change proposed as a part of the recommended plan should have no effect on sea turtle movement.

Green Sea Turtle.

The green sea turtle is distributed over a wide range of tropical waters. Adults migrate between nesting and feeding areas. Nesting time varies with locality but ranges between March and December. The closest nesting sites to the Gulf of Mexico are on the east coast of Florida and on the Yucatan Peninsula, Mexico.

Young green sea turtles are carnivorous but the adults are herbivourous. The adults frequent marine grass beds along the entire coast of the Gulf of Mexico.

Green sea turtles have not been sighted in the Atchafalaya Bay area. Indeed, this species seems to prefer rocky bottom substrates which are rare along the Louisiana coast. If they were to occur in the project area, the most likely areas for them to be would be near or in the submerged aquatic vegetation beds around Marsh Island and the Derniere Islands. These islands would not be affected by the recommended plan.

Ivory-billed Woodpecker.

This woodpecker formerly was a resident throughout the virgin bottomland forests and swamps of the entire project area. Its disappearance throughout virtually its entire range generally coincided with logging operations, although some evidence indicates that excessive collecting was a contributing factor in some areas (Tanner, 1942, as cited by National Fish and Wildlife Laboratory 1980). Apparently, the ivory-bill is a nomadic "disaster species", moving into areas where trees have been killed by fire, storms, insect attack, or flooding (Dennis, 1967, as cited by National Fish an Wildlife Laboratory, 1980). It appears that within the Mississippi Delta region, ivory-bill distribution was limited to the higher parts of the "first bottoms," which were rarely covered with water more than a few months each year (National Fish and Wildlife Laboratory, 1980a). This zone is characterized by a forest association in which the dominant trees are sweet gum, oak, and ash.

It is possible that a few ivory-bills still live within the project area. Since 1971, a number of unconfirmed sightings have been reported in the northern parts of the Lower Atchafalaya Basin Floodway (Dwight LeBlanc, personal communication). This region contains large

areas of bottomland forest which could sustain a small remnant population.

The proposed plan would undoubtedly have significant impacts upon the ivory-bills remaining within the project area (if, in fact, they do remain). Two project features would be responsible for these impacts.

Environmental easements would have a beneficial impact since they would help maintain the existing bottomland forests on which the birds depend. Some lumbering of these forests would occur in the future and this could decrease habitat quality, but it appears that virgin forests are not necessary for the survival of this species (Dennis, 1967, as cited by National Fish and Wildlife Laboratory, 1980).

On the other hand, the recreational development features of this plan would have an adverse impact upon ivory-bills. This would occur because these features would greatly increase public usage of the areas which may be inhabited. As much as an annual one million user-day increase could occur. These increased visitations would increase the likelihood that accidental or deliberate shooting of the few remaining individuals would occur. Such shooting is thought by authorities, such as Herbert Stoddard and Whitney Eastman, to have been the primary reason that these birds were originally reduced to near extinction. These same authorities believed that ivory-bills had a better chance for survival in a situation where large land holdings owned by timber companies was the rule (Eastman, 1958, as cited by National Fish and Wildlife Laboratory, 1980). It should be noted that the location of one of the reported sightings of this bird is within the tract of land donated to the State of Louisiana by Dow Chemical Company.

In summary, this plan may have net adverse effects upon the ivory-billed woodpecker if, in fact, they do still exist within the project area.

Arctic Peregrine Falcon.

This bird occurs within most of the project area only during migration. It does, however, occur as an occasional winter resident along the Gulf Coast portions of the area south of Morgan City. The primary reason for the peregrine's decline and endangered status appears to be the effects of pesticide poisoning upon reproduction (National Fish and Wildlife Laboratory, 1980b).

It is probable that this bird would be benefited by the proposed plan. This would be due to the environmental easement feature that would prevent expansion of agricultural activity within the Lower Atchafalaya Basin Floodway. This would help prevent an increase in pesticide and other pollutant concentrations in the food supply of these birds on the wintering grounds along the coastal portions of the

project area.

Bald Eagle.

Bald Eagles occur within the project area both as migrants and as winter and spring residents. Eggs are laid during November or December and young hatch during January or February. Generally, both adults and juveniles leave the area by early summer. Nests are usually constructed close to water in living cypress trees. Fourteen nest sites are known to exist within the project area and most of these are located adjacent to the Terrebonne Parish marshlands in the southernmost part of the project area (Dugoni, 1980). Two features of the recommended plan could affect these birds.

Environmental easements would benefit eagles in the same way as was discusssed previously for the arctic peregrine falcon by helping prevent increased pollution in the lower parts of the project area.

Recreational development features would adversely affect eagles by increasing the numbers of persons present in the project area. This could lead to increased disturbance of nest sites and increased possibility of accidental or deliberate shooting. Shooting has been the most frequent single cause of death among autopsied bald eagles throughout the entire United States (Coon et al., 1970, as cited by Griffin et al., 1980).

In summary, it is concluded that the recommended plan would have no net impact upon eagles.

Eskimo Curlew.

This shorebird occurs within the project area only as a transient during the spring migration from South America northward to the Arctic. Several confirmed sightings have been made along the Louisiana coastal area. The most probable time this bird would be present is in March (Greenway, 1958, as cited by National Fish and Wildlife Laboratory, 1980). The project area contains little habitat that is suitable for this species. Some use of intertidal areas along the gulf coast might occur.

It seems highly unlikely that the recommended plan could have any impacts upon these birds.

Eastern Brown Pelican.

The historic range of the eastern brown pelican included the entire Louisiana coast. The pelicans nested on several barrier islands and at sites in the Mississippi Delta. By 1963, no pelicans were nesting

in Louisiana. The likely causes of the population decline include weather, vandalism, disease, predation, starvation, and extremely high chemical pollution.

A breeding population of brown pelicans in Louisiana originated from young birds transplanted from Florida. Breeding began in Barataria Bay in 1971; and although a pesticide, endrin, killed 40 percent of the population in 1976, today a viable breeding population utilizes Queen Bess Island in lower Barataria Bay (Hines, personal communication; Clapp et al., 1981).

Brown pelicans usually feed in shallow nearshore and estuarine waters. The birds can range as far as 50 miles from their nesting area in search of food. During non-nesting times, they range farther. In the summer, the pelicans follow and feed on mullet and menhaden while they school in Barataria Bay. In the winter, the birds feed from the Timbalier Islands to the Mississippi River Delta.

Presently, brown pelicans are rarely seen in Atchafalaya and adjacent bays. As the population continues to increase, excluding any unforeseen catastrophe, the pelicans may begin to feed in the project area. Because these animals are extremely mobile, they can avoid any areas of disturbance to search elsewhere to feed. Any work done in Atchafalaya Bay should not adversly impact the brown pelican. Some beneficial impacts could occur due to the environmental easement feature of the recommended plan, which would help reduce pesticide pollution due to agricultural runoff.

Bachman's Warbler.

This small warbler is known to have occurred in Louisiana in the past (Lowery, 1974a) but few confirmed sightings have been made in recent years. Nesting occurs in bottomland hardwood forests. Much of the project area contains habitat that could be used by these birds. If any of these birds still occur within the project area, then it is probable that the environmental easement feature of the recommended plan would be highly beneficial to them as these easements would insure the preservation of large areas of suitable habitat.

Red-Cockaded Woodpecker.

This woodpecker is an inhabitant of pine forests. No suitable habitat of this type occurs within those parts of the project area that would be affected by the recommended plan. These birds would, therefore, be expected to occur only as transients. It seems very unlikely that the recommended plan could have any effects upon these birds.

Florida Panther.

The Florida panther may occur wherever its principal prey, the white-

tailed deer, occurs. Since much of the project area contains a significant deer population, panthers could occur throughout the area. Two apparently authentic sightings have been made recently. One occurred near Butte la Rose in 1973 (LeBlanc, personal communication) and the other near the Attakapas Wildlife Management Area in 1979 (Watson, personal communication).

Two features of the recommended plan could affect panthers. Environmental easements would be highly beneficial since they would help preserve the forest habitat needed by deer, the panther's main food source. On the other hand, the recreational development features of this plan would probably not benefit the panther as they would increase human presence in the area, which could lead to increased likelihood of death or injury due to shooting. Since only a few panthers occur within the area, the death or injury of a single animal due to increased human presence could be significant.

The net project impact to the Florida panther in the project affected area is difficult to ascertain. The increase in bottomland hardwood acreages over future-without project conditions and the subsequent increase in deer population (food supply) would certainly benefit panther populations. On the other hand, the increase in public recreation could be detrimental. Since Florida panthers are very wary, gunshot injury or mortality should not be high and this detrimental impact could be offset by the projected increase in deer population and habitat protection. Therefore, any net negative impact on the Florida panther should be minimal.

West Indian Manatee.

The range of the West Indian Manatee is from North Carolina to Veracruz, Mexico. The manatee appears to prefer areas where there is mixing of saltwater and freshwater. In the United States, the winter distribution is confined primarily to the warmer rivers and coastal areas of peninsular Florida. During the summer, the manatees disperse from the warm water refugia and travel north to western Florida and North Carolina. Individuals which have been sighted in Louisiana are most likely manatees that have traveled north from Veracruz and Tamaulipas, Mexico (Lowery, 1974b). Sightings in Louisiana include one in Lake Catherine, Orleans Parish, May 1943; one in a bayou near Baton Rouge, 1975; and one in the Atchafalaya swamp, spring 1978 (Anomymous, 1978).

Manatees are herbivorous and eat a wide variety of vegetation. Their preferences are submergent, emergent, and floating vegetation in that order.

The occurrence of the West Indian manatee in the project area is very unlikely, although individuals have been sighted in the river and swamp in the past. Atchafalaya and adjacent bays are areas of

salinity mixing, and abundant and diverse vegetation types grow in the waters. Therefore, the major limiting factors to the manatees' existence in Louisiana waters are the water temperature and the total lack of warm water refugia. If manatees occur in the project area during the warm water months, then no project features would be likely to affect them.

Sei Whale.

This whale occurs in nearshore and offshore waters of the western North Atlantic Ocean. They are migratory and move south in October to their winter range in the Caribbean and northeast and southeast Gulf of Mexico (Leatherwood et al., 1976). The only information about this species' occurrence in the northern gulf are three strandings. One of these strandings occurred in 1956 near the mouth of Fort Bayou northeast of Boothville, Plaquemines Parish, Louisiana.

Fin Whale.

This whale is a cosmopolitan species and occurs in the North Atlantic Ocean from Greenland to the Caribbean. The whales summer in northern waters and move south in October to their winter range along the coast of Florida and in the Gulf of Mexico (Leatherwood et al., 1976). In the northern Gulf, fin whales have been sighted almost every month of the year except for December and January (Schmidly, 1981). Strandings in Louisiana have not been documented since publication of the report of Lowery (1974b). The last stranding occurred in 1968 west of Venice.

Fish and Wildlife Service personnel (US Fish and Wildlife Service, personal communication) have not sighted any fin whales in the northern gulf. It is unlikely that any feature of the proposed project would impact this species.

Sperm Whale.

This species was once numerous enough in the Gulf of Mexico to support a whaling industry for 160 years. Whaling records showed that the whales were present in the north central Gulf from April through July and in central Gulf in March (Lowery, 1974b; Schmidly, 1981). However, because strandings of whales have occurred every month in the Gulf, a separate population stock could exist there.

Strandings and sighting are recorded from along the west coast of Florida and from along the Louisiana, Texas, and Mexico coasts. A stranding occurred on 6 November 1960, near Pass a Loutre (Lowery, 1974b). Recent sightings include three females and one calf at the 100-meter depth profile off the northern Texas coast, in August 1979 (Fritts and Reynolds, 1981), 14 sperm whales in 978 meters of water 40 miles south of South Pass, in August 1980, and four sperm whales in

548 meters of water off Marsh Island, in October 1980.

Although strandings and sightings of this species occur frequently, this whale is mostly confined to deep water and is rarely observed from the coast. It is unlikely that any of the project features would impact this species.

VI. SUMMARY AND CONCLUSIONS

The overall results of this evaluation are summarized in Table 2. From this, it can be seen that 12 species would not be affected by the recommended plan, two species could be affected beneficially, and two species could be affected adversely because of increased public usage of the area.

Because of the proposed increase in public recreation in the Atchafalaya Basin, an extensive public education program should be initiated by the responsible agencies to inform recreationists of the presence and importance of all endangered and threatened species. This educational program should also warn recreationists of existing state and Federal statues protecting endangered species and the violation penalties associated with those statues.

TABLE 2

SUMMARY OF RESULTS OF ENDANGERED AND THREATENED SPECIES ASSESSMENT FOR THE PROPOSED ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA PROJECT

Species	Significant Project Impacts			Net Impact		
	None	Beneficial	Adverse	No Effect	May Affect Beneficially	May Affect Adversely
Leatherback Sea Turtle	X			X		
Kemp's Ridley Sea Turtle	X			X		
Loggerhead Sea Turtle	X			X		
Green Sea Turtle	X			X		
Ivory-billed Woodpecker		X	X			X
Artic Peregrine Falcon		X			X	
Bald Eagle		X	X	X		
Eskimo Curlew	X			X		
Brown Pelican	X			X		
Bachman's Warbler		X			X	
Red-cockaded Woodpecker	X			X		
Florida Panther		X	X			X
Florida Manatee	X			X		
Sei Whale	X			X		
Fin Whale	X			X		
Sperm Whale	X			X		

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United States Department of the Interior
FISH AND WILDLIFE SERVICE
75 SPRING STREET, S.W.
ATLANTA, GEORGIA 30303

FEB 11 1980

Mr. James F. Roy
Chief, Planning Division
U. S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Mr. Roy:

We have reviewed the project area of the Atchafalaya Basin Floodway (Log number 4-3-80-A-72) as requested in your letter of January 9, 1980.

We concur with your letter and the attached list of endangered and threatened species which may occur in the project area with the following changes. The red-cockaded woodpecker (Picoides (=Dendrocopos) borealis) occurs in portions of Catahoula, Ouachita, Grant, and LaSalle Parishes. It should, therefore, appear on the list. You should also be aware that the American alligator (Alligator mississippiensis) is listed as an endangered species in all parishes of the project area with the following exceptions: the alligator is listed as a threatened species south of U.S. 190 in Pointe Coupee, St. Landry, St. Martin, Iberville, and Assumption Parishes. It is listed by similarity of appearance only in Iberia, St. Mary, and Terrebonne Parishes. [1]

In future correspondence please refer to the appropriate log number.

Once it is determined that listed or proposed species may be present, Section 7(c) requires Federal agencies to provide a biological assessment for the species which are likely to be affected. The biological assessment shall be completed within 180 days after the date on which initiated, before any contracts for construction are entered into, and before construction is begun. We do not feel that we can adequately assess the effects of the proposed action on listed and proposed species or Critical Habitat without a complete assessment. The following information should be included:

1. Results of a comprehensive survey of the area.

2. Results of any studies undertaken to determine the nature and extent of any impacts on identified species.

3. Agency's consideration of cumulative effects on the species or its Critical Habitat.

4. Study methods used.

[1]Due to a change in the law taking place after this letter was written, the alligator is no longer considered either endangered or threatened in the project area.

5. Difficulties encountered in obtaining data and completing the proposed study.

6. Conclusions of the agency including recommendations as to further studies.

7. Where an impact is identified to proposed and listed species or Critical Habitat, a discussion of efforts that will be taken to eliminate any adverse effects.

8. Any other relevant information.

The Fish and Wildlife Service representative who will provide you with assistance is Mr. Fred Bagley, Endangered Species Specialist, U. S. Fish and Wildlife Service, 200 East Pascagoula Street, Suite 300, Jackson, Mississippi 39201, telephone FTS 490-4900, commercial (601) 969-4900.

After your agency has completed and reviewed the assessment, you should send a copy of the assessment with your determination of "no effect" or "may affect" on any of the listed species. If the determination is "may affect", you shall initiate consultation by a written request to the Regional Director, Fish and Wildlife Service, Richard B. Russell Federal Building, 75 Spring Street, S. W., Suite 1282, Atlanta, Georgia 30303.

Your attention is also directed to Section 7(d) of the 1978 Amendment to the Endangered Species Act, which underscores the requirement that the Federal agency and the permit or license applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which in effect would deny the formulation or implementation of reasonable alternatives regarding their actions on any endangered or threatened species.

For your information and assistance we have enclosed a copy of the interim definitions and two "step down processes" for general guidance.

Sincerely yours,

Richard N. Smith

Acting Deputy
Regional Director

Enclosures

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

March 16, 1981 F/SER64:CDJ

Mr. James F. Roy
Chief, Planning Division
Department of the Army
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, LA 60160

Dear Mr. Roy:

This is in reply to your letter of February 17, 1981, which requested information about species which are listed or proposed to be listed as threatened or endangered as provided by the Endangered Species Act of 1973. Your area of interest is the Atchafalaya Basin Floodway Area.

As provided in Section 7(c) of the Endangered Species Act Amendments of 1978 and 1979 (see enclosed copy), the National Marine Fisheries Service (NMFS) is required to furnish a list of endangered or threatened species, both proposed and listed, which are under NMFS jurisdiction, that may be or are present in the area involving Federal construction activities. The list enclosed with your letter is not correct. Enclosed is a corrected list of endangered or threatened species that may ocur in the proposed project area. All consultations under Section 7 involving sea turtle aquatic areas are the responsibility of NMFS, while such consultations involving sea turtle nesting beaches are the responsibility of the U. S. Fish and Wildlife Service (FWS). All Section 7 consultations involving the manatee, an endangered marine mammal, are the responsibility of FWS.

For purposes of providing interim guidance, the National Marine Fisheries Service considers "construction projects" to mean any major Federal action which significantly affects the quality of the human environment designed primarily to result in the building or erection of man-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes Federal actions such as permits, grants, licenses, or other forms of Federal authorization or approval which may result in construction.

Upon receipt of the National Marine Fisheries Service's species list, the Federal agency authorizing, funding, or carrying out the construction action is required to conduct a biological assessment for the purpose of identifying listed species and species proposed for listing which are likely to be affected by such action. The biological assessment shall be completed within 180 days after receipt of the species list, unless it is mutually agreed to extend this period.

When conducting a biological assessment, the Federal agency should minimally:

(1) Conduct an on-site inspection of the area affected by the proposed activity or program. This may include a detailed survey of the area to determine if the species are present or are present at other times of the year, and whether suitable habitat exists for either expanding the existing population or potential reintroduction of populations;

(2) Interview recognized experts on the species at issue, including those within the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, State conservation departments, universities and others who may have data not yet found in scientific literature;

(3) Review literature and other scientific data to determine the species' distribution, habitat needs and other biological requirements;

(4) Review and analyze the effects of the proposed action on the species, in terms of individuals and populations, including consideration of the cumulative effects of the proposed action on the species and its habitat;

(5) Analyze alternative actions that may provide conservation measures.

At the conclusion of the biological assessment, as described above, the Federal agency should prepare a report documenting the results. The report should include a discussion of the study methods used and any problems encountered or any other relevant information.

If the biological assessment reveals that the proposed project may affect listed species, the formal consultation process shall be initiated by writing to the Regional Director, National Marine Fisheries Service, 9450 Koger Boulevard, Duval Building, St. Petersburg, Florida 33702. If no effect is evident, there is no need for further consultation. We would, however, appreciate the opportunity to review your biological assessment.

March 1981

Endangered & Threatened Species and Critical Habitats Under NMFS Jurisdiction

Atchafalaya Basin, Louisiana

LISTED SPECIES

Kemp's (Atlantic) ridley sea turtle	Lepidochelys kempi	Endangered
Green sea turtle	Chelonia mydas	Threatened
Leatherback sea turtle	Dermochelys coriacea	Endangered
Loggerhead sea turtle	Caretta caretta	Threatened
Sei Whale	Balaenoptera borealis	Endangered
Finback Whale	Balaenoptera musculus [1]	Endangered
Sperm Whale	Physter catodon	Endangered

SPECIES PROPOSED FOR LISTING

None

LISTED CRITICAL HABITAT

None

PROPOSED CRITICAL HABITAT

None

[1] The National Marine Fisheries Service appears to be in error in listing the Finback Whale by this name. The correct name for this species is Balaenoptera physalus.

If you have any questions, please contact Charles A. Oravetz, Fisheries Administrator, Southeast Regional Office, FTS 826-3366 or FTS 826-3720 or 813/893-3366 or 813/893-3720.

Sincerely yours,

for H. R. Ehlers
Harold B. Allen
Acting Regional Director

Enclosure

cc:
FWS, Atlanta, GA
FWS, Jackson, MS

APPENDIX I

US FISH AND WILDLIFE SERVICE

COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE

POST OFFICE BOX 4305
111 EAST MAIN STREET
LAFAYETTE, LOUISIANA 70502

January 13, 1982

General Thomas A. Sands, Reporting Officer
Atchafalaya Basin Project, Louisiana
Corps of Engineers
Department of the Army
P.O. Box 60267
New Orleans, Louisiana 70160

Dear General Sands:

The Final Feasibility Report/Phase I General Design Memorandum entitled "Atchafalaya Basin Floodway System, Louisiana" is being completed in response to three congressional resolutions and under the discretionary authority of the Secretary of the Army through the Chief of Engineers. The Feasibility studies were initiated by a United States Senate resolution in 1968 directing the U.S. Army Corps of Engineers (Corps) to review the Old River Control System and by United States House and Senate resolutions in 1972 directing the Corps to develop a plan for the preservation and management of the water and land resources of the Atchafalaya River Basin. The Phase I General Design Memorandum studies were initiated in 1976 to address alternative plans for accomplishing the authorized purposes of the Atchafalaya Basin Floodway project. Because of interrelationships between the studies authorized by the U.S. Congress and those authorized by the Chief of Engineers, they were combined into a single study.

Over the past decade, the Fish and Wildlife Service (FWS) has been afforded a unique opportunity to participate in front-end planning on the Atchafalaya Basin Project. The FWS has, to date, been involved in virtually every facet of project planning. We have monitored in excess of 20 biological studies within the project area and have drawn much of the data provided via these studies into two Planning Aid Reports, dated May 15, 1981, dealing with proposed water management and land use controls on the Atchafalaya Basin Floodway's fish and wildlife resources and with alternative solutions to providing flood protection to that portion of the study area below U.S. Highway 90 and east of the Atchafalaya Basin Floodway. As Department of the Interior representative on the Atchafalaya Basin Agency Management Group, the FWS has participated in the formulation and screening of alternative plans, in the selection of a tentative plan, and in the preparation of a draft environmental impact statement

and feasibility report/ Phase I general design memorandum. By letter dated August 26, 1981, the Department of the Interior furnished a FWS critique of the tentatively selected plan and related implementation proposals for the project.

Confronted with an expedited reporting schedule, the Corps, on January 4, 1982, furnished the FWS with a section of the final report entitled "Assessment and Evaluation of Final Plans" requesting that we furnish final comments prior to January 15, 1982, the date on which the final report/environmental impact statement is due at the Lower Mississippi Valley Division. This letter report complies with that request and fulfills the FWS's responsibilities under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

As in our earlier review of the tentatively selected plan, we have addressed the positive and negative attributes of the final recommended plan by project feature:

1. Distribution of Flows Through the Old River Control Structure

   Based on the recognition that stages within the Atchafalaya Basin Floodway will be dropping in the near future, due to center channel maturation, the FWS has in the past recommended flexibility in operation of the structure to allow an increase in flows into the Atchafalaya River, on an intermittent basis, to benefit aquatic resources. Conversely agricultural interests have requested a reduction in flows through the Old River Control Structure to allow for earlier planting in the Red River Backwater Area.

   We strongly support your conclusion that it would be virtually impossible to guarantee maintenance of a 70/30 flow distribution on an annual basis if flows through the structure were reduced during the months of May, June, and July, and we endorse your recommendation against such reductions of flow into the Atchafalaya River. Although we are discouraged by your determination that short term increases in flow through the structure are engineeringly unacceptable, we appreciate the need for caution in operation of the structure, particularly in view of its debilitated condition and the increasing probability of a change in course from the Mississippi River to the Atchafalaya River. Accordingly, we reluctantly support your conclusion that no short term changes in the authorized operation of the structure be recommended.

2. Training Works Along Main Channel and Outlets

We do not anticipate significant adverse environmental impacts from this action between River mile 53.0 and 116.0 if the channel training works are not constructed to an elevation which will confine greater than average annual flows. Similarly, we do not anticipate significant environmental damages from channel training works along the outlets if constructed as specified in the report. We caution, however, that continued support for this project feature could not be assumed if any future attempt is made to extend channel training works below the present mouths of the outlets (i.e. into Atchafalaya Bay).

3. Sediment Control

We endorse the concept of sediment reduction via realignment of principal distributaries in an effort to confine more sediment transport to the main Atchafalaya River. However, we must persist in our recommendation that the use of sediment traps, to remove sands and other heavy particulate matter from water entering through these distributaries, be more fully evaluated. To date, the only apparent criterion which has been used by the Corps in eliminating the latter alternative from further consideration is the "significant" land requirement (some 3,000 acres over project life) for use as spoil disposal areas. We continue to question whether the potential environmental damages of spoil disposal from maintenance of the sediment traps outweigh the sediment control benefits to be realized from this feature. We note a lack of data relative to beneficial environmental impacts that could be expected to result from the sediment-reduction contribution of these traps. In the absence of such data, upon which to base a "benefit versus cost" judgement, we believe that it is premature to eliminate sediment traps as a potentially viable and useful means of reducing sedimentation in the backswamps of the Floodway. If we assume that the combination of sediment traps and realignment of channel distributaries would remove 100 percent of the sands from the water entering through the distributaries into the backswamp during non-flood occurrences, the case for further examining the feasibility of implementing sediment traps is reinforced.

4. Increasing Flow Capacity of the Outlets

As we have indicated in the past, we are not particularly concerned with either maintaining the existing flow distribution or selecting the alternative of gradually limiting normal flows in Wax Lake Outlet (WLO) to 20 percent; however, we are firm in our belief that sediment flows through WLO should be

maximized. We believe that this action would contribute to environmental quality by increasing the delta formation in Atchafalaya Bay. We are concerned that simply increasing flows (i.e., to 80 percent) through Lower Atchafalaya River (LAR), in the absence of WLO channel realignment to maximize sediment flow through this (WLO) outlet, would result in even a larger percentage of sediment being shunted via the LAR navigation channel through Atchafalaya Bay than is presently occurring. Recent studies indicate that construction and maintenance of the navigation channel through Atchafalaya Bay have severely restricted delta development below the LAR outlet and that future channel maintenance will continue to adversely impact delta development by allowing 25 percent or more of the delta-building sediments to be directed to deeper Gulf waters. We fully appreciate the need to maintain the navigation channel through the LAR and the Bay, however, we firmly believe that more efficient use of sediments for delta-building can be made by directing them through WLO. Certainly, we would not favor the elimination of delta development below the LAR, and we do not believe that this action would preclude this development. We do envision, however, that maintaining the navigation channel through Atchafalaya Bay will continue to aggravate delta formation in that region. You have indicated that, for engineering reasons increasing sediment through WLO could be accomplished only if a 70/30 flow distribution were maintained at the outlets. If this is in fact the case, we recommend that the ongoing delta sediment model studies and the upcoming delta management studies be completed prior to reducing flows through WLO. These studies will hopefully yield results which will allow the implementation of techniques to maximize delta development while allowing the Corps to manipulate the distribution of flows at the outlets to benefit flood control and navigation. Decreasing flows through WLO prior to completion of these studies might preclude future options for maximizing delta development.

Although there is no data available from which to quantify anticipated fish and wildlife resource impacts, the Corps' proposal to enlarge the overbank area adjacent to WLO to function as a "floodway" for the release of floodwaters from the Atchafalaya Basin Floodway may be environmentally beneficial. This feature will allow the nourishment of wetlands, which are presently severed from sheet flow by the existing levee on the west bank of WLO, with freshwater and sediment from the WLO. Further, diverting flood flows via this overbank area may accelerate delta formation in Atchafalaya Bay below the mouth of WLO. This appears, from an environmental standpoint, to be a technique for increasing natural delta development in the western segment of Atchafalaya Bay.

5. Reducing Backwater Flood Damages East of the Floodway

We view the recommended delay in implementation of any extension of the Avoca Island Levee as a step in the right direction and look forward to working closely with the Corps towards the completion of the necessary studies which will hopefully lead to a rational recommendation relative to providing flood protection to that portion of the project area east of the Atchafalaya Basin Floodway. We strongly encourage that these future studies consider the full gamut of interacting hydrological conditions and problems in this area.

Achievement of the very narrow and limited objective of reducing backwater flooding would in the long run give little security to the residents and industrial developments of the area east of the Floodway. By the end of the project life, flooding from other sources (e.g. headwater and tidal) will have rendered many of the existing developed areas uninhabitable. Thus far, alternatives (e.g. ring levees) for protecting the entire backwater area, or at least developed portions of that area, from all sources of flooding has never been given serious consideration since the Corps' existing authority would not allow resolution of other flooding problems.

Accordingly, we strongly support expansion of the Corps' existing authority to include resolution of all identified flooding problems in the area east of the Floodway. It is obvious from the Corps' recognition of the need for further studies in this area, that hydrological conditions have changed over the past 30 years, the period since the Avoca Island Levee was first recommended as the solution to this area's flooding problems. It is further obvious that a comprehensive solution to all flooding problems east of the Floodway is long overdue, and should be sought in lieu of a short-term solution to backwater flooding alone.

6. Water Management Concept for the Floodway

We essentially concur with the Corps' recommendations relative to implementation of two pilot management units and perhaps others in the future, depending on the effectiveness of the pilot units in accomplishing desired goals. It should be remembered, however, that the present design of management units is conceptual in nature and that the Corps should actually be requesting Congressional authority to do whatever can be reasonably done to mimic historical overflow patterns and to improve water circulation and quality throughout the entire Basin. Such actions might include immediate implementation of

canal closures or circulation improvement features prior to total implementation of the water management program within any specific area of the Basin.

The water management units proposed will, at best, only retard the rapid degradation of the fish and wildlife resources, caused in part by past Corps activities in the Atchafalaya Basin. Present indications are that a gradual reduction in fish and wildlife resources, as compared to existing conditions, will still occur, even with water management units in place. At best, then, we can strive, through the management unit concept, to accomplish the formerly agreed-upon goal of maintaining, as nearly as possible, the 1972 environmental conditions in the Basin.

7. Land Use Controls Within the Floodway

We support the compromise real estate proposal announced by Governor David C. Treen on November 19, 1981, which provides for a tightening of the comprehensive habitat preservation easement to be acquired over privately-owned lands in the Floodway and donations and purchases from willing sellers of some 100,000 acres within the Floodway for public access. We do recognize, however, that the degree of public access provided for in that proposal does not fulfill the objective of maximizing public opportunity to observe and utilize the fish and wildlife resources of the Floodway. The proposal provides for no guarantee of access on overflow lands in the Floodway and provides for terrestrial access on less than 25 percent of the privately-owned lands of the Floodway. Access to overflow lands is assumed to be secure, based on the belief that a legal access right to these overflowed lands presently exists. This assumption is of concern to us, since the Louisiana State Attorney General has been asked to render a legal opinion on this issue and has thus far not done so.

8. Management Entity

We concur with the Corps' recommendation that recreation and environmental features of the plan be operated and maintained by appropriate Louisiana State agencies. We believe, however, that the Congressional Directives which mandated this study, by virtue of the fact that they call for the development of a comprehensive plan to preserve and manage water and land resources of the Atchafalaya Basin, including provisions to reduce sedimentation and improve water quality and commercial and sport fishing (i.e., management units), clearly intended for such activities to be treated as integral to the project and its operation. Accordingly, we believe that the Corps is obligated to adhere to the provisions of its own regulations

(ER 1105-2-129), which place the responsibility for operation and maintenance costs, particularly as related to water management units, which are integral to the project, with the Federal government. Governor Treen's real estate acquisition proposal does ask for such financial assistance as an integral part of the project. We support the appropriateness of that request.

We trust that we have been responsive to your needs and look forward to working with the New Orleans District on future studies related to this project.

Sincerely yours,

David M. Gilbert, Acting for

Gary Hickman
Area Manager